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Original Articles.

OPTICAL ILLUSIONS OF MOTION.

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THERE are frequent occasions of conflict between the receptive faculties of the senses and the reflective faculties of the intellect, occasions on which the mind, prejudging of the sensation received, assigns it to a non-existent cause. Of all the senses none is more frequently the seat of such deceptive judgments than that of sight; and in the science of Physiological Optics a very considerable share of attention is claimed by optical illusions. For the purposes of convenience, we may draw a distinction between these illusions, which are the direct result of certain properties or imperfections of the eye as an optical instrument, and those which arise from obliquities of judgment in interpreting the sensations optically impressed upon the retina of the eye. In practice, however, it is almost impossible to draw a hard-and-fast line between the two classes of illusions, almost all partaking of both characters. Thus, for example, it has lately been shown that we habitually draw geometrical forms too large in the horizontal dimension as compared with their vertical dimension; we draw oblate ellipses where we intend to draw circles; the explanation of this being that with our *two* eyes we really *see* spheres as oblate ellipses. Here is, in

fact, an illusion of pure association—yet based upon the facts of physical and physiological optics. So, again, certain inequalities in the curvature of the lenses of the eye, producing the optical defect of astigmatism, cause objects that are horizontal in position to form images at shorter (or longer as the case may be) distances from the eye than the images of vertical objects; the result being that, unless the defect is corrected by suitable lenses, vertical and horizontal objects (such as the bars of a window) do not appear to be at the same distance from the observer, though really equally remote. This would, at first sight, appear to be a purely physical illusion, and not psychological. Nevertheless, a little consideration will show that since our perception of distance is a psychological factor in the case, and that this perception is based in part upon the muscular sensations of adjustment of the lenses of the eye to exact focus, the illusion is one which has a psychological as well as a physical *raison d'être*. Again, take some illusions ordinarily supposed to be one purely of mental association: the common illusion of every day that the sun or moon when a few degrees from the horizon looks larger than when high in the sky, appears at first sight to be due simply to the fact that when the orb is near the horizon the distant objects upon that horizon whose size we know, or can judge of, appear relatively small, and the sun's disc relatively large—in fact, that the illusion is one purely of association of ideas. Nevertheless, when we look a little closer into the matter, we find that our simplest conceptions of angular or apparent magnitude are very closely bound up with, if not directly due to, the sensations of muscular fatigue in moving the eyeball or head so as to bring the successive parts of the object into the centre of vision.

Hence, although optical illusions are of many diverse kinds—illusions of colour, illusions of form, illusions of size, illusions of distance, illusions of solidity, and illusions of motion—they have all to be considered from the twofold standpoint, the purely optical and the psychological.

For some months the writer of this article was engaged upon a study of one set of optical illusions, namely, the illusions of *motion*, and a number of observations, collected at intervals

over several years, have been added by him to the stock of knowledge previously gleaned by Brewster, Wheatstone, Faraday, Plateau and others. Brewster made a number of observations in the early days of railways on the various illusions which can be found by watching objects from a moving train; Wheatstone investigated a curious case of apparent fluttering motion at the border of two brightly illuminated coloured surfaces—due probably to the attempt of the unachromatic eye to obtain fruitlessly a distinct focus of the border line between the unequally refrangible colours—known as the illusion of the "Fluttering Hearts;" Faraday investigated the illusions produced by intermittent views of moving objects, since developed in the Phenakistiscope and the Zoetrope, and kindred toys, and due to persistence of visual impressions. Brewster, moreover, drew attention to the existence of another class of illusions—illusions of subjective complementary motion—the typical case of which occurs also in railway travelling. After looking out of the window at the pebbles and other objects lying beside the line, as they pass before the eyes, let the eyes be closed suddenly, when there will at once be perceived an apparent motion in the opposite sense, undistinguishable forms and patches of light seeming to rush past the blank field. This was recorded by Sir David in 1848, and the phenomenon was referred by him to a subjective complementary motion going on simultaneously, and so causing a compensation of the impressions moving over the retina. A kindred phenomenon had been even earlier noted by R. Addams, who, in 1834, narrated how, after looking for some time at a waterfall and then at the waterworn-rocks immediately contiguous, he saw the rocky surface as if in motion upwards with an apparent velocity equal to that of the descending water. This he ascribed to an unconscious slipping of the inferior and superior recti muscles of the eye-balls, which he thought occurred while watching the falling water, and which he supposed to continue unconsciously after the gaze had been transferred to stationary objects. This explanation differs from the one offered by Brewster, namely, that there was a subjective *opposite* movement going on simultaneously, so causing a compensation of the impressions

moving over the retina. Brewster's hypothesis is, indeed, extremely vague, and is neither physical nor psychological in any exact sense. If understood physically, it means that there is actually motion in the retina itself, which is hardly conceivable, since the structure of the rods and cones almost precludes even any idea of vibration, or of propagation of waves of motion by vibration, much less any movements of them as a whole. And, if the explanation is intended as a psychological one, something further is needful before the principle of compensation here laid down could become intelligible.

The first experiments made by the writer of this article upon illusions of motion arose from a casual observation in 1876. He had been preparing, for the purpose of testing astigmatism, a set of concentric circles in black and white, such as those shown in Fig. 1. Happening to shake the sheet on

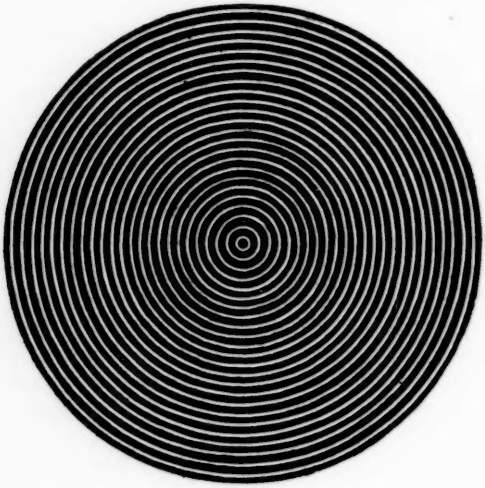

FIG. 1.

which the circles were drawn, he noticed an apparent motion of rotation to be set up. The illusion is easily produced by imparting to the pattern a slight motion of the same character as that adopted in *rinsing* out a pail, but with a very minute radius of motion. All the circles will appear to rotate with the same angular velocity as that imparted. Now undoubtedly

the persistence of visual impressions has a good deal to do with the production of this illusion, which, by the way, succeeds best when the circles make from two to four turns in a second, and when the radius of the imparted motion is equal to the thickness of one ring, so that each black or white band is displaced through a distance equal to its own width in all directions successively. Nevertheless, the persistence of visual impressions will not explain all the facts of this curious illusion: for, in the first place, it is found that for increasing distances from the eye the concentric rings must be made wider if the illusion is to succeed; there being apparently one particular magnitude of their images on the retinæ which favours the production of the illusion. Again, if two such "strobic circles" (as I have called them) are printed side by side on one card, that set of circles seems to turn most effectively at which the eye is *not* looking. On stopping the "rinsing motion" suddenly, there appears to be, for an instant, a reverse motion. Finally, if a set of circles is "rotated" while another set lies motionless within the field of view, the second set will appear to rotate when the first are "rotated" in

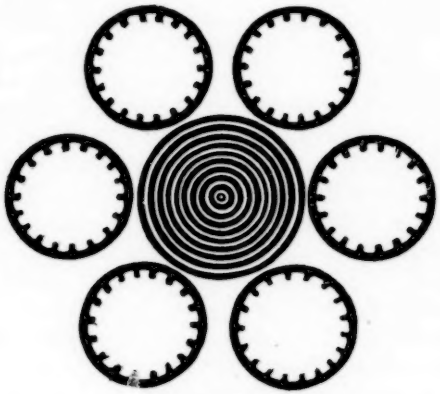

FIG. 2.

the manner described above. It is possible, also, to have a number of such apparent motions going on at once independently in one field of view. Fig. 2 shows a compound

pattern, containing an interior set of concentric circles and six internally-toothed wheels. When a very minute "rinsing" motion is imparted to this figure, the circles appear to whirl round while the toothed-wheels work slowly backwards, moving through one tooth while the circles whirl round once. Here again persistence of vision is concerned— but not exclusively.

Dr. Emile Javal, the able director of the Ophthalmological Laboratory of the Sorbonne, has recently advanced an explanation of these illusions different from that adopted by the writer, and in substance identical with that advanced by R. Addams in the case of the waterfall illusion. He avers that the eye, in order to observe a movement, follows the moving body for an instant and then suddenly slips back; that this oscillation, frequently repeated, is associated with a sensation of motion in the particular direction in question; and that when the eye is subsequently directed to a stationary object it continues the habit of thus oscillating, causing the observer to attribute to the object a velocity of opposite sign to that just observed. M. Javal alleges in support of this view the appearance presented in the ophthalmoscope of the retina of a person affected with *nystagmus*. This affection consists in continual rapid involuntary movements to and fro of the eye. The retina, under these circumstances, appears to be animated with a vibratory motion which M. Javal declares to be identical in character with the apparent movements of the circles. In another place, M. Javal has endeavoured to prove that the interior and exterior recti muscles of the eye-ball are more prone to this slipping than are the superior and inferior recti, and that these illusions of complementary motion succeed better for motions in a horizontal sense than for vertical and oblique motions. My own experience, and that of other observers, admits of no such conclusion being drawn.

An experiment of Brewster's, which the writer tried without knowing at the time that Brewster had employed it,[1] has an important bearing on the muscular-slipping theory. A disc

[1] The same experiment was also tried by my friend J. Aitken, Esq., of Darroch, Falkirk, who independently observed the phenomenon described by Addams, and who has also communicated to the Royal Society of Edinburgh a number of experiments on kindred illusions.

marked out into black and white sectors, as in Fig. 3, was caused to rotate at about one revolution per second, so that the separate sensations of black and white were not confused. The eye was steadily directed for twenty or thirty seconds at the central point, and then the gaze was suddenly turned upon some fixed objects, or at a distant landscape. For two or three seconds a hazy rotation is noticed at the centre of the field of vision. Now if the muscular-slipping theory holds good, the complementary movement of rotation must be due to a slipping of the whole of the muscles of the eyeball, and would affect objects all over the field of vision with an equal

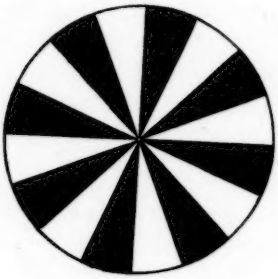

FIG. 3.

FIG. 4.

angular velocity. This is not the case, the apparent complementary rotation being confined to the central field, and with apparent angular velocities increasing toward the centre of vision. Furthermore, I have arranged two such discs so that they could be simultaneously in the field of view while rotating in opposite directions. When the gaze was directed first at a point between them and then at fixed objects, there appeared to be two portions of the field of view rotating, and animated with rotations in opposed senses. Clearly the eye cannot slip round in opposite directions at the same time. In all these illusions, moreover, it is found that this illusory complementary motion only occurs over limited parts of the field of view—namely, those which correspond to the portions of the retina which previously received the moving images. Thus, if a waterfall be looked at—as in Addams's observation—

the upward illusory after-motion is confined to a vertical streak across the field of vision. This fact alone is sufficient to negative the theory of muscular slip.

The final test to which I have appealed is, if possible, even more conclusive. It is probably a familiar observation that the end of the last carriage of a retreating railway train appears to shrink down smaller and smaller as it subtends a decreasing angular magnitude in the field of view. After looking at this motion for a sufficient number of seconds to fatigue the eye, stationary objects appear to be expanding. To produce this illusion more effectually, I take a disc like that shown in Fig. 4 (the figure is quarter actual size), marked out in spirals of white and black. If this is slowly rotated—say at about one revolution in two seconds—the whole pattern appears either to be running into, or running out of, the centre of the disc: there is a motion of convergence or divergence, according to the sense of the rotation. Let the disc be turned so as to cause an apparent convergence from all sides to the centre, and let the eye steadily watch the centre for about a minute, or until the fatigue becomes almost unendurable. Then look at any fixed object—the pattern of the wall-paper, or the dial of a clock—the object so regarded will for some two, or three, or more seconds, appear to be expanding from the centre outwards. The effect is still more startling if the object thus viewed be the face of a familiar friend. It is quite evident that the eyeball cannot slip in all directions at once.

I have therefore somewhat reluctantly been led to propound an explanation for these illusions, embodying the theory of them in an empirical law based upon the physical fact of retinal fatigue, and on the psychological fact of association of contrasts. It is as follows:—*The retina ceases to perceive as a motion a steady succession of images that pass over a particular region for a sufficient time to induce fatigue; and on a portion of the retina so affected, the image of a body not in motion appears by contrast to be moving in a complementary direction.* This law is precisely similar to that of the complementary subjective colours seen after fatiguing the retina by the image of a coloured body. Similar laws of physico-psychological after-

effects are abundant. A steady sound of one constant pitch ceases to be heard until we become aware of it by its cessation. A steady light of one colour, such as the yellow light of gas-flames, ceases to be noticed as a yellow light until some other colour-sensation break the illusion. The same is true of smells, of tastes, of the sensations of temperature, of the sensation of rotation after a waltz, and of many others. All these are probably only different instances of the operation of some much more general physico-psychological law. It is quite consonant with these kindred phenomena that when any region of the retina is affected by an image of objects moving steadily across the corresponding portion of the field of view in any given direction, that portion of the retina gradually loses consciousness of the motion, and perceives it only as a steady sensation, or as one of approximate rest. When, however, an object really at rest is looked at, the associative faculty seizes upon the contrast in the sensations affecting that region, and interprets the new sensation by imputing a motion in the opposite sense to the objects occupying the corresponding portion of the field of vision. I have proposed to give to the empirical law expressing these matters the name of the *law of subjective complementary motion.*

It is impossible to quit the subject without pointing out two lines of thought suggested by that which has been advanced.

Firstly, it is conceivable that the explanation here propounded may at some future time be superseded by a better hypothesis of a more purely physical character. Suppose, for example, that it could be shown—what I have reason to suspect, but have been foiled in all attempts to prove in any experimental fashion—that the eye has the power of altering at will the actual size of the retinal images by a double muscular adjustment between the magnifying power of the lenses of the eye and the distance of their equivalent optical centre from the surface of the retina, such a fact, once established, would entirely cut away the significance of my crucial test with the rotating spirals; and the apparent expansions and contractions of objects would be merely due to the continuous attempts of the eye to retain the retinal images of one constant size. If this were so (though I have failed in

every kind of attempt to devise some satisfactory test), it might also explain one little matter that is still very mysterious and unexplainable, namely, that in these illusions of expansion and contraction the changes of apparent magnitude often appear to take place by discontinuous jumps rather than by steady motions.

Secondly, it is found that these different illusions affect different individuals with very different degrees of success, some persons being much more sensitive than others to the after-workings of the subjective motion; and, indeed, there are individuals in whose case it is almost impossible to produce the illusions. Doubtless some of these differences may be accounted for by defects of vision, astigmatism, achromatopsy, myopy, and the like. But there is also a time-element in the case which varies very greatly with individuals, and even varies with the nervous states of the same individual. And this suggests the further thought that a careful comparison of individuals relatively to their illusion-capacity might elicit some interesting and perhaps valuable facts concerning the relation between the states of brain-organisation and the sensations of the more highly specialised organs of sense.

ON SOME POINTS IN THE DIAGNOSIS AND TREATMENT OF BRAIN DISEASE.

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It is a singular fact that, while pathological changes in certain areas of the cerebral substance invariably cause definite groups of symptoms, and can therefore, unless the patient succumb rapidly, be diagnosed with great certainty during life, on the other hand, coarse lesions may be discovered after death in important parts of the brain, without having manifested their presence by any apparent deviation from health during the patient's lifetime. There are those who contend that this latter event only occurs in slowly-growing tumours, which do not so much destroy the parts the sphere of which they invade as push them aside, and which increase so gradually in bulk as to give the structures concerned sufficient time to adapt themselves to altered circumstances, and to preserve their functions, however much their normal situation and nutrition may be interfered with. This opinion, however plausible at first sight, appears to us untenable, for we shall have to show that almost any morbid processes, such as hæmorrhage, softening, abscess, atrophy, tubercle, as well as the various forms of tumours habitually encountered in the brain-substance, such as glioma, sarcoma, osteoma, &c., may exist in important localities without giving rise to those special symptoms which we seem almost to have a right to expect under those circumstances. On the other hand, the reverse of this may be observed clinically in numerous cases, viz., that grave symptoms showing considerable alteration of brain-function exist, in which nevertheless coarse lesions are eventually shown to be absent, inasmuch as these symptoms yield completely to certain modes of

treatment which could not, with any show of reason, be supposed to have a curative influence upon such occurrences as hæmorrhage, softening, or tumour. Then again patients die occasionally with the symptoms of ingravescent apoplexy, and yet no hæmorrhage or other serious cerebral lesion is discovered on inspection.

By far the commonest form of brain disease to be met with in practice is hemiplegia, which comes on suddenly, affects the lower branches of the portio dura and the corresponding upper and lower extremity, is followed by late rigidity, and remains more or less permanent. In such cases we can say with a great degree of certainty that the opposite corpus striatum, and more particularly its internal capsule, must have been injured. It is true that a similar group of symptoms may be observed (*a.*) in disease of the upper portion of the pons Varolii; (*b.*) of the crus cerebri; (*c.*) of the centrum ovale; and (*d.*) of the central convolutions and the paracentral lobule of the cineritious substance of the hemispheres; yet we know by experience that hæmorrhage and softening, being the most frequent causes of the ordinary form of hemiplegia, have a special predilection for the corpus striatum, which receives its blood-supply chiefly from the lenticulo-striated arteries. These vessels, being the immediate continuation of the middle cerebral, and therefore the carotid artery, are more than others exposed to direct cardiac pressure, and therefore more liable to aneurismal dilatation and rupture. As embola are for the same reason more liable to be carried into them than into other vessels, necro-biotic softening from embolism is more frequent there than elsewhere; while thrombosis has no particular affinity to the vessels supplying the corpus striatum, and softening from thrombosis therefore occurs elsewhere as much as there.

With regard to hemiplegia from disease of the other brain-portions just mentioned, it is found that:

(*a.*) Lesions of the *pons Varolii* only rarely cause that form of hemiplegia of which we have just spoken, but almost invariably a motor paralysis which is known as alternate hemiplegia of the extremities and certain cranial nerves, more especially the sixth, the portio dura and the hypoglossus, which latter are paralysed on the side of the lesion, while the ex-

tremities are paralysed on the opposite side. Moreover anarthria or dysarthria is generally observed at the same time, and difficulty of deglutition, impairment of the circulation and respiration, and anæsthesia of the paralysed side of the face, *may* be found. The presence or absence of all, or some of these symptoms, will therefore enable us to pronounce for or against a pontine lesion.

(*b.*) Disease of the *crus cerebri* may cause crossed hemiplegia of the lower branches of the portio dura, the hypoglossus, and the corresponding upper and lower extremity; yet in some of these cases the fifth, and in more, the third nerve will be found paralysed, the latter suffering alternately with the other nerves, i.e. on the side of the lesion, while the other cranial nerves, together with the extremities, are paralysed on the side opposite to the lesion. Such unusual symptoms as third- and fifth-nerve paralysis, in connection with hemiplegia, are therefore quite sufficient to guide us in our diagnosis of such cases.

(*c.*) Disease of the *centrum ovale* cannot at present be diagnosed with any degree of probability. This structure may be extensively diseased without giving rise to any symptoms whatever; and where symptoms are present, we find crossed paralysis, either in the form of hemiplegia or monoplegia, leading us to suspect at first sight disease of the corpus striatum or certain portions of the cortex. Pitres has attached importance to the presence of unilateral convulsions, affecting the paralysed parts only, as distinctive of disease of the centrum ovale; but he has not succeeded in showing that in these cases there was not likewise irritation of certain portions of the cortical substance, which we know to give rise to this class of convulsions.

(*d.*) Disease of the *cortex* does, in exceptional cases, give rise to the ordinary form of hemiplegia such as we are in the habit of associating with corpus striatum disease; yet, where the antero-parietal or postero-parietal gyrus, or the paracentral lobule, or all these parts together are affected, the hemiplegia is generally "dissociated" or piecemeal; that is, we find paralysis of the arm and leg without any affection of cranial nerves; or paralysis of the arm alone; or of the arm and the

portio dura; or there is ptosis, and paralysis of the portio dura and hypoglossus, without affection of the extremities; besides which there may be certain forms of anæsthesia. Signs of motor irritation are the rule, either previous to, or after the occurrence of the paralysis, and appear as chronic spasms always affecting the same sets of muscles in one side of the face, or the corresponding extremities, and which often merge into general epileptiform convulsions.

Amongst those portions of the brain which may be found extensively diseased without there having been any symptoms during life, we would hardly expect to find the *medulla oblongata*, seeing the extreme physiological importance of the numerous centres which are there crowded together in a small compass. We know injury to the medulla to be immediately fatal; and any sudden interference with its structure, such as the rupture of a miliary aneurism and consequent effusion of blood into it, is likewise incompatible with life. Death is under those circumstances so sudden that one is inclined to attribute it to heart-disease ("apoplexie foudroyante" of the French authors). Such cases are very rare; and embolism of the vertebral artery leading to necro-biotic softening of the medulla is, for anatomical reasons, even more rare. On the other hand, thrombosis from disease of that blood-vessel is somewhat more frequent, but does not kill nearly with the same rapidity as hæmorrhage; for as the artery is only gradually occluded, the patient may survive for a few days, and present symptoms of apoplectiform bulbar paralysis, viz., dysarthria, dysphagia, paralysis of the soft palate and stertorous breathing, hoarseness or complete aphonia, hiccough, cough, vomiting, and irregular respiration and circulation leading to cyanosis. This cluster of symptoms coming on while consciousness remains intact, is highly characteristic for the lesion of which we have spoken. It is true that Charcot and Lépine have drawn attention to a somewhat similar concourse of symptoms arising from certain cortical lesions; but in the latter there is rarely dyspnœa or cyanosis, and *the symptom of aphonia occurs in no cerebral affection whatever except one of the medulla*, so that by this sign alone the diagnosis may be rendered certain.

While therefore in sudden lesions of the medulla, such as

hæmorrhage, or apoplectiform softening from thrombosis, symptoms of the utmost gravity are observed, we find, on the other hand, that this complex organ will apparently not resent disease coming on in a more insidious manner. Dr. Wilks has recorded the case of a girl who was admitted into Guy's Hospital, complaining of occipital headache. There being no other symptoms, the pain was thought functional, possibly hysterical. Two days afterwards she was found dying, respiration having suddenly become arrested. As the heart's action continued, artificial respiration was had recourse to for eight hours; and the heart continued to beat for twenty-five minutes after the cessation of these therapeutical efforts. At the post-mortem examination a glioma was found in the medulla infiltrating and encroaching on all the important centres, including the fourth ventricle. Other cases in which there was an almost entire absence of symptoms, have been seen by Ollivier, Louis, and Schulz. In the latter's, there was a glioma occupying almost the entire thickness of the medulla, of which only a small zone of nervous matter remained. There was also sclerosis of the lateral columns of the spinal cord, which during life had caused the symptoms of spastic paralysis; but no sign referable to the medullary disease had been noticed.

Next in vital importance to the medulla oblongata comes the *pons Varolii*, disease of which is much more frequent than that of the medulla. Hæmorrhage is almost invariably fatal, but not with such extreme suddenness as when the effusion takes place into the medulla, two or three hours generally elapsing between the first onset of the symptoms and death; yet where the clot is large, and presses considerably on the medulla, the fatal issue may be more sudden. Embolism of the basilar artery, which would lead to necro-biotic softening of the pons, does not occur for anatomical reasons; while thrombosis of that vessel, more especially in syphilitic subjects, is by no means rare. According to the extent of the thrombosis the symptoms may vary considerably, which need not surprise us, seeing the number of centres and conducting paths which exist in such abundance in this most complex structure. There are no cases of hæmorrhage or softening on record in which not some at least of the symptoms of alternate paralysis were present, viz.,

crossed hemiplegia of the limbs, and equilateral paralysis of the mouth, divergent strabismus, and anæsthesia of one side of the face, as well as dysarthria.

It is, however, different with tumours which, if growing very slowly, may become developed without causing any symptoms, and even gradually attain a considerable size. Such cases have been recorded by Hallopeau, Laborde, Henoch, and others. In Laborde's case there was a tubercle of the size of a filbert in the centre of the pons; and in Hallopeau's there was an area of tubercular disease in the central portion of the organ, which measured 2½ centimètres in its largest diameter. These cases are however exceptional, since generally speaking the symptoms in pontine tumours are of a most varied description, consisting in the sphere of motion of paralysis and convulsions, muscular rigidity, lock-jaw, nystagmus, pendulum-like movements of arm and leg; in the sphere of sensation of pain and of anæsthesia, which affects the face and the extremities, the affection being crossed in the latter; to which are sometimes added certain vaso-motor and trophic phenomena.

There is no portion of the brain where the peculiarity which we are considering obtains so frequently and with all different kinds of disease as the *cerebellum*, a circumstance which renders the diagnosis of cerebellar affections a matter of peculiar difficulty, and sometimes one of impossibility. Not only tumours, but hæmorrhage, softening, abscess, atrophy and tubercle, have been discovered by such observers as Bourneville, Nothnagel, Heusinger, and others, in which during life absolutely no symptom was noticed. In Ebstein's case, almost the entire left hemisphere was destroyed by an osteoma; in Lallement's, there was complete atrophy of the left lateral lobe without tumour, and also atrophy of the right olivary body, and part of the right corpus striatum; in Heusinger's, there was an abscess in the right lateral lobe which was apparently four or five months old; in Nothnagel's, a cicatrix in the corpus dentatum, which was evidently the remains of old hæmorrhage, the patient having eventually died of dysentery; in Mosler's case, an area of inflammatory softening in the nucleus dentatus of the left lateral lobe of the size of a pigeon's egg, the patient having suffered from diabetes and died of pleurisy without any symp-

toms on the part of the nervous system; while in Andral's case (that of a boy who died of pulmonary consumption) four tubercles in the left lateral lobe were found, three of them being of the size of a cherry and one of a filbert. Instances like these might be multiplied indefinitely, while in others again a variety of symptoms has been observed. As a general result it may be stated (*a.*) that there are no symptoms where the disease is localised in one lateral lobe, and where it does not produce pressure on neighbouring parts, such as the middle lobe, the pons Varolii, the medulla, or the corpora quadrigemina; and disease of one of the lateral lobes is therefore as a rule impossible to recognise during life; (*b.*) that symptoms of a definite character occur almost invariably where the middle lobe is affected; (*c.*) that the principal symptoms are the "reeling gait" (cerebellar ataxy) and a peculiar form of vertigo; and (*d.*) that all other symptoms which have been noticed in cerebellar disease, such as optic neuritis, vomiting, certain forms of paralysis and convulsions, nystagmus, headache, various kinds of anæsthesia, paræsthesia, and hyperæsthesia, deafness, and symptoms of mental disturbance, are uncertain and inconstant, and generally owing to pressure of tumours on distant parts, or to co-existing disease in other organs.

Of the *crura cerebelli*, only those which connect the organ with the pons Varolii—the middle crura—seem to give rise to special symptoms when diseased, while the inferior crura which connect the cerebellum with the medulla, and the superior ones which link it with the optic lobes, may become diseased without apparently resenting it. Again, simple destruction of the middle crura, as by hæmorrhage or softening, may pass unperceived, while irritation of these parts, chiefly by growing tumours, causes characteristic appearances, provided the connection between the crura and the cerebellum be not completely destroyed. These consist of certain forced movements or positions of the body, head or eyes, over which the patient himself has no control whatever, and which, if disturbed by others, at once reassert themselves. They occur sometimes in a state of unconsciousness; and where the patient is conscious, resistance on his part to such forced movements or positions is unavailing. Sometimes they appear in the form of fits, so that

the body is turned right over in bed four or five times consecutively, by the action of the spinal muscles, the patient occasionally resisting such movements by taking hold of the bed-clothes, but without effect. In other cases the patient remains constantly lying on one side, and if his position be shifted by the nurse, returns at once to the one previously assumed. Conjugate deviation of the head and eyes may also occur, or, as in Nonat's case, one eye may be turned outwards and downwards, while the other is directed inwards and upwards. The presence or absence of coma is of some importance in such cases; for conjugate deviation of the head and eyes is known to occur in hæmorrhage of the central ganglia, pons Varolii, and the meninges, together with coma, while in disease of the middle crura it may occur without coma.

The *crura cerebri* are, in their progress from the anterior border of the pons Varolii towards the central ganglia, often implicated in disease of the latter, yet may suffer by themselves of hæmorrhage, softening, &c., owing to disease of the external posterior optic arteries (Duret). As a rule, the symptoms are well marked, there being either crossed paralysis of the extremities, the portio dura, and the hypoglossus; or these symptoms are combined with equilateral paralysis of the third nerve, thus constituting a form of alternate paralysis which is peculiar, and from which a definite conclusion as to localisation in the crus may be drawn; while, of course, simple crossed paralysis of the extremities, the portio dura and the hypoglossus, may be due to a variety of other lesions. The paralysis of the third nerve may be complete, when there is ptosis, external strabismus, and diplopia; or it may be incomplete. In either case, however, the lesion appears to be seated in the internal portion of the crus, while affection of its external portion is more apt to cause anæsthesia than paralysis. No local symptoms were observed in a case of Gintrac's, where a tubercle of considerable size was found in the right crus of a boy six months of age; and of Delasiauve's, where an encephaloid growth was discovered in the left crus.

Localised softening and hæmorrhage do not appear to occur in the *corpora quadrigemina* or *optic lobes*, no doubt owing to their deriving their blood-supply from the posterior cerebral

arteries, which also nourish the optic thalami and other neighbouring parts, so that the latter are apt to be affected simultaneously. Griesinger taught that, when vision was normal, there could be no affection of the optic lobes; yet cases have been recorded by Kohts, Gowers, and Steffen, in which destructive lesions of these parts were unaccompanied by blindness. The whole subject is still involved in much obscurity, inasmuch as tumours may, simply by causing an increase of intra-cranial pressure, give rise to the choked disc, optic neuritis, and other symptoms, which have nothing whatever to do with their localisation in the optic lobes. Yet it appears probable that disease of the posterior portion, or the nates, is less likely to cause amaurosis than lesions of the anterior portion, or the testes; while on the other hand, palsies of certain branches of both third nerves seem to speak for affection of the nates.

If there be obscurity in the pathology of the optic lobes, Cimmerian darkness may be said to prevail in the sphere of the optic thalami, concerning which the best observers are at this moment in a state of apparently hopeless discrepancy. This is no doubt owing to the circumstance that truly localised lesions, whether from hæmorrhage, softening, or tumour, are very rare in these parts, and that in most cases which come under observation, extensive pathological alterations co-exist in important neighbouring structures. In consequence of this, the most fundamental points are as yet undecided, such, for instance, as whether the optic thalami have anything to do with the sense of sight or not, whether they are centres of common sensation or not, whether lesions in them give rise to the ordinary form of hemiplegia or not, &c. One fact, however, is certain, viz., *that hæmorrhage may occur in these parts without giving rise to any symptoms at all;* and Nothnagel has recorded a case in which there was even bilateral hæmorrhage in the thalami without the least suspicion of cerebral disease having been excited during life. This also holds good for tumours, as in Gintrac's case there was tubercle in both thalami in a patient who had never shown symptoms of brain-affection.

With regard to paralysis, it may be said that its presence speaks rather against, than for, disease of the thalamus.

Complete destruction of its posterior third has been seen without a trace of paralysis; in lesions of the middle third, paralysis has only been noticed when the area of disease was very extensive, and may therefore be inferred to have exercised pressure on the internal capsule, while where the area was small, no paralysis was present; and finally, disease of its anterior third is so constantly associated with destruction of the corpus striatum, and more especially the internal capsule, that the hemiplegia which is present in such cases, has to be referred to the latter structures. Common sensation was formerly believed to centre in the thalamus and to suffer from its destruction, but this theory has, for the present at least, been disposed of by the researches of Lafforgue. On the other hand, Crichton Browne has rendered it probable that disease of the thalamus causes diminution or abolition of reflex excitability, more especially in the upper extremity; and finally, certain forms of motor irritation, such as hemichorea, athetosis, and tremor, seem to be connected with disease in this part. Nevertheless we may say that the best-informed physician cannot at present diagnose disease of the thalamus with any degree of certainty.

(*To be continued.*)

RECURRENT HEADACHES IN CHILDREN.

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HEADACHES are of such common occurrence in young people that no physician whose observations are made largely among children, can fail to meet with many cases in which headache is the main subject of complaint. In dealing with this group of cases from a scientific point of view, it is evidently necessary to define the physical conditions which may be taken as signs of that mobile or irritable condition of the nervous system in which headaches are so common.

The study of diseased conditions of the brain has been greatly advanced by observing the conditions of the muscles of the face, eyes, limbs, trunk, &c. It is by the clonic muscular twitchings in chorea that we know the brain is choreic; it is by the condition of hemiplegia we are led to infer that there is a lesion in the basic ganglia of the opposite hemisphere; it is by the observation of labio-glosso-laryngeal paralysis that we diagnose disease of the olivary body. If, then, we would conduct our observations in the case of children who suffer from recurrent headaches on principles and lines of investigation similar to those which have led to important results in the study of chorea, hemiplegia, and other cases of organic disease, we must carefully observe the condition of the muscular system in such patients. Following upon these lines of argument, I have in many cases examined and recorded the conditions of muscles supplied by cranial nerves, and those of the upper extremities.

It is a matter of common observation that a patient may "look as if he had a headache."

Such an appearance of the face can only result from its colour, form, or mobile conditions, for these are its only distinguishing characteristics.

In children it is not uncommon to have "the expression of headache in the face;" so frequently was it observed, that I came to look upon it as a physical sign of the condition which produces headache.

A face may be analysed as to the three properties spoken of, and that as to either half of the face, or as to the upper, middle, or lower portions. If either vertical half of the face be covered in turn by a paper, "the expression of headache" is seen equally on each side, proving that the cause of the expression is bilaterally symmetrical. If the paper be held with one margin horizontal it may be made to cover in succession, (1) the forehead down to the level of the eyebrows; (2) the parts about the eyes from the eyebrows to the lower margins of the orbit; (3) the parts from the lower margin of the orbits downwards, including the mouth, cheeks, and alæ nasi.

In analysing faces to see wherein lay "the expression of headache," I looked at the faces of adults, and the expression seemed retained as long as the parts about the eyes were seen and lost when the middle zone was covered, i.e., this peculiar facies appeared due to the condition of the parts about the orbicularis oculi. There seemed to be a loss of tone in this muscle; there was an appearance of fulness and flabbiness about the lower eyelid; the skin hung too loose, and in place of falling against the lower eyelid neatly, as a convex surface, it fell more or less in a plane from the ciliary margin to the lower margin of the orbit. This condition is often seen best by looking at the patient's face in profile. This condition of the parts about the eye may often be seen in children, unaccompanied by any general change in the skin of the face, such as the flabbiness seen in emphysema, and the loose inelastic skin of senile decay. The expression is not due to local œdema, for it does not pit, and may often be removed instantly by causing the expression of joyousness or laughter, when the orbicular muscle is energised and temporarily recovers its tone.

More might be said of this antithesis of the muscular state in the opposite conditions of the centres of feeling. It is not suggested that the appearance of the face accompanies headache only, it is common in many conditions of depression.

Something might also be added of the partial ptosis and pigmentation of the lower eyelid sometimes seen.

The muscular condition of the hand in such patients seems to me equally characteristic with that of the face. There is a nervous condition of the hand, as there is a nervous condition of the face, and each can be described in anatomical terms. As the child stands up, holding his hands out before him on a level with the shoulders, palms downwards, and fingers spread out, there may often be seen a peculiar and, I think, characteristic condition of the hand. The wrist droops slightly, at the same time the phalanges are extended backwards upon the metacarpus, the second phalanges being slightly flexed, and the ungual phalanx either flexed or in a straight line with the middle phalanx. The thumb is usually simply extended backwards and somewhat abducted from the fingers. I think that this position of the hand may be taken as an item of evidence that the child is of a neurotic habit, with mobile nerve-centres; it may be seen in girls convalescent from chorea, and in others who are weak and nervous. This "nervous hand" is sometimes seen more marked on the left than on the right side. I have now under observation a lad and a man, both the subjects of partial hemiplegia apparently from organic disease, in whom this "nervous hand" is well seen on the weak side. Twitchings of the fingers were very commonly seen, the movements being usually of independent digits, and most commonly either lateral or flexor, less commonly extensor; the lateral movements appeared the most characteristic.

Believing that "the nervous hand" was owing to the condition of its muscles, and that the condition of its muscles was owing to the condition of certain nerve-centres, the conclusion arrived at was that the position of the hand must indicate the condition of those nerve-centres.

Considering the illustrations that Darwin has brought forward to prove that the emotions are expressed by the exercise of certain muscles, and that in opposite emotional conditions (i.e. opposite conditions of nerve-centres?) the antithesis of the emotional condition is expressed by an antithesis of the muscular condition, my observations were directed by this principle of antithesis.

A hand almost the antithesis of "the nervous hand," and

expressive of force and energy, is often seen in men when speaking earnestly. Here the wrist is extended, the metacarpo-phalangeal joints and interdigital joints are flexed, the thumb is also moderately flexed.

It is of course the 7th cranial nerve which connects the facial muscles with their nerve-centres. If the centres of the 7th nerve are disturbed in conditions of depression it is reasonable to inquire if the muscles supplied by other cranial motor nerves show any signs of relaxation or disturbed equilibrium.

The 3rd, 4th, and 6th nerves supply the eye muscles. Evidence of disturbance of the motor division of the 5th nerve is seen in the great frequency of tooth-grinding. In a large proportion of my cases, the teeth were found flattened upon their edges, as the result of tooth-grinding. This condition may, I think, be taken as another physical sign of the nervous condition. We know that the sensory branches of the 5th nerve are largely distributed to the meninges.

The tongue is supplied by the 9th nerve, and this when protruded was usually very unsteady, but not distinctly jerked in and out as in chorea.

There appears to be some evidence of disturbance of the pneumogastric nerve in the varying condition of the appetite, which is often voracious, often very poor; vomiting may accompany or succeed the headaches. Illusions of sight with headaches, such as sparks, colours, hemiopia, &c., are in my experience much more rare in children than in adults.

I found that very commonly the urine was of high specific gravity, reaching up to 1030 or 1035, and loaded with urea. Uro-hæmatin was also usually abundant; in both these facts these children correspond with those suffering from chorea.

Fifty-eight cases were arranged in a tabular form, as follows, showing the relations to age and sex :—

Ages.	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–15
Males 25	1	2	2	8	2	1	2	2	4	1	0
Females 33	0	2	3	1	2	5	5	4	2	4	5
Totals 58	1	4	5	9	4	6	7	6	6	5	5

Heredity produced a marked predisposition to this neurotic condition; in the 58 cases there was a history of recurrent headaches in the mother in 24 cases, in the father in eight cases, while in three cases there were examples of insanity in the family. In looking at the faces and heads of children suffering from headaches, I found in many cases signs of rickets, and when in the general clinique of children the patient was seen to be rickety, headaches were found in most instances; it seems then that rickets in childhood is a strongly predisposing cause of recurrent headaches.

METHODS OF PREPARING, DEMONSTRATING, AND EXAMINING CEREBRAL STRUCTURE IN HEALTH AND DISEASE.

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I.

COARSE EXAMINATION OF THE BRAIN AND ITS MEMBRANES.

IMPORTANT and necessary as are the minute investigations made by microscopic agency into the normal structure of the brain or its pathological deviations, we must guard ourselves from the very serious error of considering this method as essentially and exclusively necessary in these studies. The error to which I allude is a common one, and is too apparent to need much comment upon my part; for all who are engaged in the prosecution of cerebral histology must have recognised the prevailing tendency to disregard the naked-eye appearances of the brain, or to regard them as of very secondary import compared with a minute investigation aided by the complex armamentarium of the microscopist. If any of my readers are possessed of this notion I would ask them at the outset to rid themselves immediately of the fallacious idea which, if fostered, must prove a serious obstruction to the acquirement of that intimate acquaintance with the true significance of the varied appearances presented by normal and diseased tissues. The skilled obstetrician recognises as an invaluable acquirement that *tactus eruditus* which a constant and intelligent employment of a special sense can alone confer; and no less should the histologist endeavour to obtain a special visual tact, a highly refined and educated visual power which can alone enable him to recognise by the unaided eye appearances which pass wholly unnoticed by the casual observer. I cannot too strongly insist upon this point, for he who would successfully study the morbid anatomy of the brain must, as in

the morbid anatomy of other tissues, begin seriously to educate the eye to the coarse appearances presented to the unaided vision. The employment of a hand-lens of two to four inches focal length will prove of service here, the naked-eye appearance being contrasted with the magnified field, and the eye thus educated up to recognising characters which without the aid of the lens were previously indefinite or unrecognisable. Nothing beyond repeated and energetic efforts in this direction will enlarge the area of the visual field and present to the mind the manifold appearances which constitute an unbroken whole, and which are absolutely necessary to a refined interpretation of the picture presented to the mind's eye. Repeatedly have I had occasion to observe that the student, after a full curriculum of hospital training—a training which should pre-eminently involve the high culture of the sense of sight, hearing, and touch—fails wholly to appreciate the most obvious abnormalities of the cerebro-spinal tissues, and this because he has neglected to tutor the eye so far as to learn what to look for, and how to look for it. If you place before him the brain of a case of chronic mania, without coarse lesion, and note his observations upon the appearances of a section across the hemisphere, it will be found that beyond a statement that the grey matter is pale, anæmic, and wasted; that the white matter is altered in consistence, and presents numerous coarse vessels, his untutored eye teaches him no more; and should he be examined even for the grounds upon which these statements are made, a too evident vagueness will be apparent —his ideas on relative depth of cortex or anæmic states of the brain and consistence of its tissue are gauged by no mental standard, and are remarkable only for their indefiniteness. The practised eye of the histologist, however, sees far more; the relative depth of cortex in various regions; the relation borne by this depth to normal standards; the varied depths of the several laminæ of the cortex, their distinctness of outline, general and local vascularity, as well as the deviations in hue dependent upon fatty or upon pigmentary changes. The œdematous, degenerated aspect of the medullary tracts, the presence of minute sclerosed patches, and a host of other morbid appearances, present to his mind a picture which the

unpractised eye wholly fails to appreciate. To those who are liable to err in the direction pointed out, I now address myself in the hope of rendering their studies of the naked-eye appearance of healthy and diseased brain more inviting and instructive, by means of a few simple directions as to what appearances are to be sought and how they are to be looked for.

A few further statements on the object and scope of these articles may not prove amiss.

I address myself almost exclusively to the student who, up to the present time, has devoted but little of his attention to cerebral pathology or to the histology of the central nervous system; and more especially to asylum medical officers, whose opportunities for research in this field are so numerous, yet so sadly neglected. Recognising personally the want of a concise summary of methods of examination of the nervous centres, I shall endeavour here to place at the disposal of the student the more important, essential, and trustworthy information in this department which I find scattered promiscuously throughout an extensive literature. If amongst these gleanings my remarks should appear to the advanced student burdened by too much detail, my excuse must be that the primary object is to overcome the difficulties presented by these studies to the novice, difficulties which every expert observer has at the beginning to encounter.

THE DURA MATER AND VENOUS SINUSES.

General Anatomical Considerations.—It is necessary here that the student should recall to mind certain anatomical details affecting the relationships of this membranous investment of the brain which have an important pathological significance, and in the first place note that:

a. The dura mater is a fibro-serous membrane; the outer surface being fibrous and rough, the inner being smooth and polished by a layer of epithelial cells constituting a parietal arachnoid.

b. Cut off a small portion and float it in water. The rough pilose outer surface due to the numerous fibrous connections and vessels which unite it to the inner table of the skull

becomes hereby very apparent in contrast to the smooth inner surface.

c. Next, note that the dura mater is composed of two distinct layers, which, by their divergence, occasion the formation of the different venous sinuses; whilst the inner layer, by its duplications, forms the various intra-cranial membranous partitions, the falx cerebri and cerebelli, as well as the tentorium.

d. Lastly, observe the close anatomical relationships between the lateral sinuses and the mastoid cells, and again between the superior petrosal sinuses and the internal ear. Caries of the petrous portion of the temporal bone and of its mastoid cells is so frequent an affection, that the contiguity to them of these venous sinuses is most important as likely to occasion not only localised pachymeningitis or inflammation of the opposed dura mater, but inflammation and thrombosis of the venous sinuses, leading probably to metastatic deposits in the lung.

e. The position of the venæ Galeni, which receive the blood returning from the choroid plexuses and open into the straight sinus, is such that tumours or abscesses of the mid-lobe of the cerebellum would compress them.

Upon removal of the skull-cap the student should proceed to investigate the condition of the dura mater after the following systematic manner:

1st. Note the general aspect of the membrane covering the hemispheres.

2nd. Examine the several venous sinuses.

3rd. Observe the condition of the dura mater in those regions at the base where there exists a special proclivity to disease.

1st. *As to the general appearance of the Dura Mater at the vault.*—A glance at the superficial aspect of the dura mater may reveal the presence of inflammatory products which are frequent here. If present note their character, whether they are simple, inflammatory exudates, capable of undergoing organisation, or whether they are the results of suppurative inflammation. In the former case, observe how softened the membrane is, and how readily separable from the bone; in

the latter case the presence of pus will almost certainly lead to the detection of a carious state of the internal table and diploë of the skull, and a more or less sloughy aspect of the disintegrating membrane. The organisable blastema may be found in various stages of development, as loose areolar or thick tough fibrous tissue, or it may have formed bony plates which eventually unite with the cranial bones. Should dense fibrous bands be formed, adhesions betwixt the dura mater and bone occur, chiefly along the course of the sutures, or in localised islets over the frontal or parietal bones, or so extensively that it is impossible to remove the skull-cap without at the same time including the dura mater, as their forcible separation would entail injury to the brain.

If there be the above given indications on the surface of recent or of old inflammation, note (1) the density, (2) thickness, (3) swollen (4) appearance, and (5) colour of the membrane at these parts. Recent inflammations involve much swelling, interstitial infiltration, softening and looseness of texture, and a very red colour; whilst the effects of an old inflammation are seen in a callous fibroid induration and thickening, often with bony concretions formed in the interstices of its texture, together with the adhesion to the inner table of the skull just alluded to.

The student must be prepared to make allowances for the general increase in thickness and firmer adhesion of the dura mater, which pertains to advanced age independent of inflammatory changes. Superficial inspection will also enable him to detect attenuation of this membrane such as results from the pressure of a hypertrophied brain, from the effusion of hydrocephalus or morbid growths. Local thinness of this membrane also will be frequently found due to the pressure of pacchionian bodies which perforate the dura mater frequently, and imbed themselves in fossæ on the internal surface of the cranium.

Extravasation of blood forcing the membrane apart from the bone may be frequently found, and its origin should be carefully sought.

2nd. *Examine the larger Venous Sinuses.*—A fold of dura mater close to the longitudinal sinus at its exposed frontal extremity must now be pinched up by forceps, and the

scalpel passed through it and down into the longitudinal fissure of the brain, so as to divide the union betwixt the falx cerebri and crista galli. Introduce a curved bistoury into the anterior end of the longitudinal sinus, and carry the blade backwards to its occipital extremity so as to expose this sinus throughout its greater extent. The oblique orifices of the veins of the vertex which empty themselves into this sinus will now be exposed. Note—

(1.) The capacity of the sinus throughout.

(2.) The nature of its contents.

(3.) The condition of its lining membrane.

The incision through the frontal end of the falx cerebri should now be extended on either side through the dura mater backwards, upon a level with the sawn edge of the cranial bones. The anterior extremity of the falx being then seized with forceps should be drawn forcibly backwards from between the hemispheres, carefully dividing the great superficial veins where they open into the sinus, when the convolutionary aspect of the brain covered by its soft membranes will be exposed to view. At this stage of dissection the pia mater, arachnoid, and superficial aspect of the brain will require attention, and the method to be adopted will be detailed in the following section, to which the student must be referred. Continuing, however, our examination of the sinuses of the dura mater, it must be presumed that the brain has been removed, and the following procedure will then be necessary:

Lay open the larger venous sinuses at the base, commencing at the torcular Herophili behind, and carrying the blade down each lateral sinus to the foramen jugulare. Open up the straight sinus running into the torcular Herophili in the base of the falx cerebri. Deal in like manner with the petrosal and cavernous sinuses.

A close inspection of these sinuses should be instituted with the object of learning the nature of their contents, and the morbid or healthy condition of the textures of these venous channels. The most frequent morbid conditions found here are those of phlebitis and thrombosis, the thrombus being usually the result of inflammation of the walls of the sinus.

Thrombosis of the venous sinuses of the dura mater is so

frequent and so important an affection, that the possibility of its occurrence should always suggest itself when examining this membrane.

If a thrombus obstructs any one of these sinuses, note the more or less organised condition of the clot and its adhesion to the lining membrane of the sinus.

Examine closely its apparent site of origin and extensions, the latter often reaching into the jugular veins.

Next take into consideration the constitution of the clot, whether recent, organised and firm, or breaking up and presenting the appearance of a crumbling mass, which, during life, would give rise to metastatic deposits in distant organs.

The condition of the lining membrane and tissues of the sinus should next be noted. If inflamed, the inflammatory action should be traced to its origin, usually in a carious state, of the cranial bones; or by extension of simple inflammation of the dura mater in the neighbourhood of the sinus; or less frequently, induced as a secondary result of thrombosis. The student should carefully study the effect of plugging of the different sinuses, and their proclivity to disease as a result of their varied anatomical relationships.

a. Inflammation of the longitudinal sinus will be accompanied by occlusion of the venous trunks from the convexity of the brain where they open into the sinus.

b. If the straight sinus be occluded as the result of adhesive phlebitis, the student will remark that its effects in obstructing the return of blood from the choroid plexus will be similar to what occurs when the venæ Galeni are compressed by a tumour of the mid-lobe of the cerebellum. Effusion into the ventricles might be expected in these cases, and the enlargement of the head from this cause has been recognised clinically.

c. If the lateral sinus be inflamed, we might expect as a result extension of phlebitis into the jugular veins, and plugging of the smaller sinuses or veins opening into it. In connection with this—note, that the small "emissary veins," (Santorini) which perforate the bone at the anterior extremity of the lateral sinus, and which form a communication between the sinus and the veins on the outside of the skull at the back of the head, may become plugged by a thrombus producing a

painful œdema behind the ear, also recognised clinically by Griesinger.[1]

d. The position of the petrosal and lateral sinuses naturally exposes them to phlebitis and thrombosis. Lying on the petrous portion of the temporal bone, they are always liable to be implicated by extension of inflammation from the internal ear and caries of the temporal bone.

e. Thrombosis of the cavernous sinus has been frequently noted. In connection with this condition the student must be prepared to note the pressure which will probably result to the carotid artery which runs through this sinus invested by its lining membrane.[2] He may also look for extension of inflammation of the coats of this sinus to the facial veins with which the ophthalmic vein communicates, as well as to obstruction to the return of blood from the cavity of the orbit.

f. Amongst other results of thrombosis of the cerebral veins and sinuses, will often be found punctiform hæmorrhages into the substances of the brain.

3rd. Observe the condition of the dura mater at the base where there exists a special proclivity to disease. The sites alluded to are:

1. Petrous portion of temporal bone.
2. Ethmoidal plate.
3. Parts adjoining superior cervical vertebræ.

THE ARACHNOID AND PIA MATER.

General Anatomical Considerations.—In proceeding to investigate the healthy and morbid appearances of the arachnoid the following anatomical facts will prove serviceable to the student.

1. The arachnoid is usually regarded as consisting of a parietal and visceral layer like ordinary serous sacs, the former however (parietal layer) being merely a layer of nucleated polygonal epithelium lining the inner surface of the dura mater; the latter forming the far more substantial investment

[1] Quoted by Niemeyer in 'Text-Book of Practical Medicine,' vol. ii.

[2] This condition has been recognised clinically by a loud bruit heard on auscultation of the skull. Dowse. 'Lancet.'

of the convolutions of the brain separated from them by the pia mater. This closed sac is lubricated by a portion of the general cerebro-spinal fluid.

2. The visceral layer of arachnoid does not dip into the sulci with the pia mater, but bridges them across, whilst in other regions it is widely separated from the pia mater so as to enclose between them extensive spaces. Thus at the base a delicate veil of arachnoid stretches across the pons and inter-peduncular space as far as the optic chiasma; a similar film of arachnoid closes in the fourth ventricle stretching across from the medulla to the cerebellum; the arachnoid also does not pass down to the bottom of the longitudinal fissure, but spans across immediately beneath the falx cerebri; hence a space is left here between the two inner membranes of the brain immediately above the corpus callosum.

3. The various spaces alluded to above all communicate freely with one another, and with an extensive space around the whole length of the spinal cord betwixt the pia mater and arachnoid sac. The whole system of spaces is termed the sub-arachnoid space, and is filled by the greater bulk of the cerebro-spinal fluid.

4. A space intervenes between the parietal layer of the arachnoid and the dura mater. It has been fully investigated and described by Axel Key and Retzius,[1] and is called by these anatomists the sub-dura-mater space (subduralraum). The student must therefore regard the membranous investments of the brain as consisting of a firm and immovable fibrous outer membrane, the dura mater forming also the periosteal lining of the cranial cavity; of an intermediate serous sac or arachnoid whose visceral layer moves freely with the movements of the hemisphere; and lastly, of a vascular membrane supporting the blood-supply of the brain—the pia mater, which closely lines the cortex dipping into the sulci and being prolonged into the ventricles.

Between the various investments are four great cavities:

1. The subdura-matral betwixt dura mater and the parietal arachnoid.

[1] 'Studien in der Anatomie des Nervensystems.' Axel Key und Gustav Retzius. Stockholm, 1875.

2. The arachnoid cavity formed by the arachnoid sac.

3. The sub-arachnoid cavity betwixt visceral arachnoid and pia mater.

4. The epi-cerebral space betwixt pia mater and cortex.

It must also be borne in mind that compensatory adjustments for lessened or decreased intra-cranial pressure are obtained by means of the cerebro-spinal fluid; increase in the pressure, as in the increased amount of blood, growth of tumours, &c, being allowed for by escape of this fluid into the spinal sub-arachnoid space. In relation to this important subject it has been shown by Axel Key and Retzius that the pressure of the cerebro-spinal fluid is always higher than that of the venous blood and its specific gravity lower, hence its free mingling with the blood-currents by osmosis is much facilitated.[1]

Coarse Methods of Examination.—The healthy and morbid appearance of the arachnoid should be subjected to close and critical examination.

Upon reflecting the dura mater the contents of the arachnoid sac will be revealed, and in relation to this point we must note:

1. Variations in the amount of cerebro-spinal fluid here.

2. Modified appearance of this fluid from admixture with morbid products.

3. Note expecially extravasations of blood, and the age of these hæmorrhages as revealed by the condition of the clot. It may be purely fluid blood, coagula, or a delicate film of fibrinous nature; or it may be in various stages of organisation. The various stages of the arachnoid cyst in relation to pachymeningitis have all been most graphically described.

4. Note the superficial aspect of the visceral and parietal arachnoid as regards—

a. Absence of clear, moist, glistening surface.

b. Presence of morbid deposits, such as films of lymph of varied appearance and stage of organisation; as a delicate greyish mucus-like exudation, or a membrane possessing a certain amount of consistence, or flakes which are yellow and puriform, and more

[1] 'Studien in der Anatomie des Nervensystems.' Axel Key und Gustav Retzius. 1875.

rarely fibroid patches; or, again, the development of bony plates in the parietal layer.

c. Adhesions between layers of arachnoid sac, such as occur naturally by the development of the pacchionian bodies.

5. Note the anomalies of texture due to interstitial change and to deposits occurring here. The effect of frequent hyperæmia is seen in the opalescent, creamy white or perfectly opaque appearance presented, especially along the course of the blood-vessels, and always seen after middle life to a greater or less extent. Hypertrophy of the textures, giving the membrane a tough and thick character, will result from similar causes. The membranes may be however soft, tumid, and swollen from œdema of its texture; and where it bridges the sulci a solid gelatiniform aspect is often given it by the fluid subjacent.

6. The relative amount of cerebro-spinal fluid in the subarachnoid space should next be taken into account. It should be collected, together with that which escapes from the arachnoid sac and ventricles, and carefully measured. The appearance of the arachnoid, when buoyed up by any undue amount of this fluid, should be noted before removal of the brain from the skull. It will be found that in these cases the arachnoid is widely separated from the pia mater by the subjacent fluid. The limpid character of this fluid may be tested by slitting up the arachnoid over a sulcus.

So far our remarks chiefly apply to the arachnoid, and we will now turn our attention to the pia mater. The proximity of these two membranes to one another of course predisposes to their common implication in any morbid process, yet the pia mater is occasionally involved without extension to the brain substance, and still more frequently without extension to the arachnoid. In healthy states these membranes are very thin and delicate, and removed from the brain surface only with difficulty. We should therefore note their proximity to each other over the summits of the gyri, alterations in the thickness of the pia mater and in its toughness, infiltrations of its texture, and the ease or difficulty experienced in its removal from the cortex.

Thus the pia mater may be found widely separated from the arachnoid, the latter being buoyed up by sub-arachnoid effusion. In these cases the appearance of the fluid should be noted, especially as regards the presence of inflammatory exudates, as flakes of lymph, &c.

If thickened in texture the alteration of the pia mater should be traced to its origin, whether this be simple serous infiltration or œdema conjoined with inflammatory material. Tortuosity and varicosity of the vessels will also be further indications of repeated congestions of this membrane. Especial caution must be observed against drawing hasty conclusions regarding congestion of the membranes from the mere fulness of their blood-vessels and hypostasis.[1]

The student will find ample opportunity for studying the appearances presented by œdema and thickening of the soft membranes of the brain in cases of senile atrophy, general paralysis, and alcoholism.

The presence of inflammatory material modifying the thickness and toughness of the membranes should lead to a study of the nature of the exudate, whether it appears as a tough exudate of plastic lymph more or less yellowish in hue, or more serous, sero-purulent, opaque, and less organisable material.

With the presence of these more or less plastic exudates note the general infiltration of the membranes around with greyish, opaque serum. Such changes afford excellent opportunities for the study of the results of inflammatory action in loose areolar tissue. In connection with inflammation of the pia mater, a condition which will frequently engage the attention of the student, he should also follow up his investigation of the *nature* of the exudate by examining also:

a. The *direction* taken by the morbid product, noting that this occurs almost invariably along the vascular tracts, the course of the vessels being marked out by opacities.

b. The *extension* to neighbouring structures (brain, arachnoid, dura mater, and skull).

c. The *restriction* of inflammation to *limited areas* (as when

[1] On this point see Niemeyer. Art. Hyperæmia of Brain and its Membranes. 'Text-Book of Medicine,' vol. ii.

originating secondarily from caries of the cranial bones); or to the *convexity* of the hemispheres (chiefly accompanied by plastic products); or, lastly, characterised by the *base of the brain* being originally and chiefly involved (usually accompanied by aplastic and tubercular products).

Note attentively the greater or less facility of stripping the pia mater from the cortex. The membrane may be œdematous, thickened, gelatinous, and most readily removed; or, on the other hand, it may cling with greater tenacity or adhere so firmly that portions of the cortex tear away with it, leaving an eroded, worm-eaten aspect of the surface of the gyri. Attention should be directed to the strength of these adhesions, their implication of the summits of the gyri only, their localisation over the convolutionary surface of the brain, and the coarseness of the blood-vessels entering the cortex at the sites of adhesion. Whenever the student is engaged with a case of meningitis, the morbid topography must be carefully studied. If basic, the veil of arachnoid extending from the optic chiasm to the pons must be examined and removed, noting implication of the numerous vascular and fibrous twigs extending betwixt it and the subjacent pia: follow these results of inflammatory action up along the vessels of the fissure of Sylvius and along the anterior cerebrals in the longitudinal fissure. Examine the regions just named for tubercular granulations, paying especial attention to the smaller blood-vessels which may have tubercular masses in their sheaths, occluding more or less the calibre of the vessel. Should granulations appear around the blood-vessels, let them be removed and floated in water for more careful observation.

ARTERIAL SYSTEM OF THE BRAIN.

After carefully noting the external appearance of the membranes covering the hemispheres both at the vertex and the base, the condition of the arterial system should be inquired into. The brain being placed with its base uppermost, the fine expanse of arachnoid which bridges across the inter-peduncular space is first removed, and the great vessels forming the circle

of Willis will then be exposed to view. Now separate the temporo-sphenoidal lobe from the adjacent frontal and parietal lobes by dividing the bridge of arachnoid extending between them across the Sylvian fissure. On gently drawing back the temporo-sphenoidal lobe the Sylvian branch of the middle cerebral artery will be observed running deeply in the fissure towards the upper extremity of the latter, giving off small branches in this course. The radiating gyri of the island of Reil (central lobe) will in most cases be only partially exposed, and it will be necessary to separate the operculum, or that portion of the third or inferior frontal convolution which laps over the anterior portion of this lobe. The five or seven gyri of the island will now be seen radiating outwards like a fan and supporting the various branches derived from the middle cerebral artery in the sulci between them. Split up the arachnoid which bridges across the longitudinal fissure anteriorly from one frontal lobe to the other. We shall thus have exposed the various branches of the circle of Willis as far as they can be seen at the base. Note first the arrangement of the blood-vessels.

A first glance at the arrangement of the great arteries at the base of the brain entering into the formation of the circle of Willis cannot fail to impress upon the student's mind this important fact: there are here *two great arterial systems more or less distinct and independent.* In front lies the *carotid system*, supplying by far the greater bulk of the brain; behind lies the *vertebral system*, distributed to the posterior and inferior regions of the cerebrum—an area small in comparison to the former. These two great arterial systems are united by the two posterior communicating arteries which connect each carotid with its corresponding posterior cerebral artery. Examine the posterior communicating arteries and note the remarkable smallness of their calibre, a fact which suffices to ensure us that the circulation in the carotid and vertebral systems is in the main distinct; whilst the arrangement allows of compensatory enlargement and a free communication betwixt both systems where emboli, thrombi, or diseased textures obstruct the circulation of a main branch.

Next observe the junction between the two anterior cerebral arteries deep in the longitudinal fissure by means of the cross

branch, the anterior communicating artery. Raise the branch on the forceps and note its short length, small calibre, and right-angled direction—facts which teach the student that, although in case of obstruction on the carotid side of the anterior cerebral artery, this branch by dilating may afford a satisfactory re-establishment of circulation over the area to which it is distributed, yet for the greater part the circulation betwixt the two anterior cerebral arteries is distinct.

A little further consideration will teach him that the circulation of each hemisphere is by the above mechanism rendered wholly distinct and independent; that the circulation of the mid-cerebral region of one side is wholly separated from that of the opposite hemisphere; whilst the anterior cerebral areas are more closely associated through the medium of an anterior communicating branch.

Lastly, through the medium of the posterior communicating artery (especially when we recall to mind the frequent enlargement of this vessel met with) there will be a far more ready communication betwixt the carotid and vertebral circulation than there can be betwixt the vascular apparatus of both hemispheres. The student should pay especial attention, therefore, to the following observations:

a. The almost complete independence of hemispheric circulation.

b. The very complete independence established betwixt the circulation of one middle cerebral and that of the other.

c. The interdependence possible betwixt the two anterior cerebral streams through the medium of an enlarged communicating branch.

d. The possible admixture of the carotid and vertebral circulation of the same side through the medium of the posterior communicating—a condition very frequently established.

The arrangement of the internal carotid ere it reaches the circle of Willis is one of interest and significance. Within its bony canal the tortuous sigmoid course taken by it is undoubtedly one means whereby the brain is protected from the results of the cardiac pulsations. The student will recall a

similar tortuous course taken by the vertebral artery ere it enters the cranium. It has long been noticed that the middle cerebral is more readily blocked by emboli than the other branches, and that the area of its distribution shows especial proclivity to hæmorrhage. Anatomical reasons, and the fact that this vessel lies "more directly in the way of strain from the heart explains its frequent plugging and rupture from disease." (Hughlings-Jackson.[1]) Thus Prevost and Cotard found that tobacco-seeds injected into a dog's carotid most often lodged in the middle cerebral artery. Again, the fact that the left carotid artery arises directly from the summit of the aortic arch whilst the right arising from the innominate is inclined at an angle to the aortic current, is sufficient to explain the greater immunity from embolism experienced by the right carotid in its distribution to the brain. The right vertebral arises from the horizontal part of the subclavian, and is therefore also less subject to embolism than the left vertebral which arises from the summit of the ascending portion of the left subclavian. (Duret.)

SUPERFICIAL VIEW OF ARTERIES AT THE BASE.

Note the following points:

a. Colour and opacity.

b. Relative toughness of coats.

c. Tortuosity or kinks in the course of the vessel.

d. Local bulgings or constrictions from diseases of texture.

a. The arteries may be perfectly white in cases of slow and lingering death, and contain a decolorised clot extending into their minute ramifications. On the other hand, they may be of a deep red hue from fluid blood, dark clots, and blood staining of the lining membrane. The vessels again may be thin and semi-transparent, or opaque from thickening of the arterial tunics and morbid deposits.

b. The toughness of the arterial tunics can be tested later on after their removal. Their resistance to strain is an important feature, and due attention should be paid to it by the student. The apparent thinness of a vessel should never

[1] 'Lancet,' Sept. 4, 1875.

be allowed to deceive him, as the thicker vessels are often most degenerated and least resistant to traction or expansion. Traction may be applied to the vessel held between two pairs of forceps, when an approximate idea of the breaking strain may be acquired, whilst the use of the conical gauge will enable him to note the various degrees of resistance these textures offer to expanding forces.

c. Tortuosity and kinks in the smaller branches should be noted as suggestive of previous forcible distension from congestion. This is apparent often in the larger arteries; thus Quain has noticed frequent tortuosity of the internal carotid before it enters the carotid canal outside the skull in apoplectic subjects.

d. Local bulgings may be due to aneurismal dilatations, to the different forms of arteritis—atheroma, tubercle, syphilitic gummata, or to the impaction of a thrombus or embolus. The arteries at the base will be found often exceedingly atheromatous, tortuous, knotty, and white; the amount of atheromatous material occluding even the larger cerebral arteries, often converting the smaller branches into irregular knotty cords. The student should never infer from the aspect or feel of such a vessel that it is occluded, but he should always make a section across the mass of diseased tissue, when if the vessel be permeable the orifice is readily detected. Note particularly the branches which are occluded. If the bulging be due to inflammatory swelling and exudation into the outer tunics of the artery, it will be observed that corresponding to the site of lesion the vessel is dilated—a condition due to paralysis of the muscular coat of the vessel, together with implication of the elastic outer tunic. Make a section across the inflamed tissue, and observe how readily the elastic or outer coat may be stripped from the muscular by means of forceps; also how friable and easily separable are the muscular fibres of the media. The inner coat will also be probably deeply stained by hæmatin, or may be eroded and covered by an adherent clot immediately beneath the inflamed patch. When a clot appears to obstruct the calibre of a blood-vessel, the character of the clot should be taken into consideration, its fibrinous constitution, stage of organisation, adhesion to vascular walls

its form, prolongations, and appearance of its section. The sheath and outer tunic of the arteries should be closely examined, especially in the neighbourhood of the Sylvian fissure and island of Reil for tubercular or syphilitic growths. Especial care must be taken to exactly note the arterial tunics involved, so as to discriminate between ordinary endarteritis resulting in atheromatous degeneration and the syphilitic node or gumma involving the outer coats, and the tubercular nodules involving the arterial sheaths, all of which lesions may give rise to blocking, contraction of the cavity, and thrombosis. Such lesions should be examined microscopically. In all cases the above superficial examination should be supplemented by removal of short lengths of any diseased vessels, to be reserved for freezing and section-cutting, according to the methods detailed hereafter in the microscopic section.

The vessels spreading over the island of Reil and up the Sylvian fissure should now be raised by passing a pair of forceps beneath them, and with a clean sweep of the scalpel they should be all divided just where they turn over on to the superficial aspect of the brain; this should be repeated on the opposite side. The two anterior cerebral arteries should now be divided at the genu of the corpus callosum, and dissected back to their origin from the carotids. The posterior cerebral arteries will be found running backwards round the crura cerebri under cover of a bridge of arachnoid. Together with the three cerebellar branches, they may be followed to a short distance and then divided. It will now be found that the circle of Willis is retained merely by the numerous minute nutritive branches, between the basilar and pons, and those from the anterior, middle, and posterior cerebrals, which pass through the anterior and posterior perforated spaces. Gently draw these vessels out by means of forceps as far as possible, sever them close to the surface of the brain, and then float off the vessels of the base into a shallow dish or plate of water, arranging the branches in their relative positions.

Capacity of the Arteries.—It may be found advisable in certain cases to test the relative capacity of the larger vessels at the base, and this may be obtained approximately by means of a small graduated conical gauge.

In making these comparisons the student should bear in mind that the united areas of the branches equal very nearly the area of the trunk from which they originated, although their united diameters far exceed that of the latter. It has been shown by Paget's measurements that the equality between the area of the trunk and of its branches is not exactly maintained, the area sometimes increasing in the vessels of the upper extremities and head and neck, and diminishing in the lower extremities. Now, according to the mathematical law that the areas of circles are as the squares of their diameters, it will be seen to be necessary to contrast in our measurements the square of the diameter of the trunk with the sum of the squares of that of the branches arising from it. The student therefore should proceed in the following manner: Let us suppose he wishes to estimate the relative capacity of the vessels at the base and their primary branches; let him remove these vessels as already recommended, and float them out in a shallow vessel containing water. With a pair of sharp scissors cut across the vessel exactly at right angles to its direction, pass the graduated cone into it, and gently draw the vessel on until it is fully distended, but not stretched, by the gauge; read off the diameter as shown on the gauge, and proceed in like manner with the other vessels. Arrange the diameter and the squares in appropriate columns, opposite the names of the vessels, for future comparison. The following tables represent the average measurements of the various vessels at the base in forty-five cases of insanity I have investigated:

	Diameter.	Square.
	mm.	mm.
Vertebral Artery—Right . . .	3·147	10·341
Left . . .	3·42	12·039
Basilar	3·82	14·805
Posterior Cerebral—Right . .	2·658	7·213
Left . . .	2·56	6·551
Carotid—Right	3·951	15·789
Left	4·02	16·026
Mid-Cerebral—Right	3·133	10·063
Left	3·55	10·351
Anterior Cerebral—Right . .	2·73	7·55
Left . . .	2·66	7·445

Thus the sums of the square of the diameters of the anterior

and middle cerebral of the right side was to that of the left side as 17·613 to 17·796.

The square of the diameter of right and left anterior and middle cerebrals amounted in the aggregate to 35·409, both posterior cerebrals reaching only 13·764.

Contrasting again the mid-cerebral supply of both sides with that of both anterior cerebrals, we find it represented by 20·414 against 14·995.

Reference to the table of measurements will show that the posterior and anterior cerebral supply of both sides is almost exactly similar: thus, on the right side, we find 7·213 contrasted with 7·55; and on the left side, 6·551 with 7·445.

Another interesting feature in connection with these measurements is the great preponderance in areas of the two vertebrals over the basilar, which they form by their union. The two former have as the sum of the square of their diameters 22·38, the basilar only averaging 14·805; and in several cases I have found the basilar, not more than one-half the area of the united vertebrals.

It may assist the student to obtain a clearer idea of these areas if he represents them graphically as straight lines upon an enlarged scale.

Vessels of the Pia Mater.—First note the general appearance and distribution of the vessels of the pia mater as they lie *in situ*. Observe the relative position taken by the veins and arteries, the former being large and superficial, the latter much smaller and concealed chiefly within the folds of pia mater, which dip into the sulci and are bridged across by arachnoid. The upper aspect in health being arachnoid, should present a smooth endothelial surface. Use a hand-lens in examining these vessels. The student should observe any fibrinous effusions, purulent exudates, or minute extravasations along the course of the blood-vessels, the presence of atheroma, morbid growths—as gummata, tubercle, &c. If tuberculosis be suspected, examine the arteries deep in the sulci, and this with care, as tubercle along the course of the vessels is found with far greater difficulty here than at the base or up the Sylvian fissure.

Next strip off a large portion of arachnoid and pia mater from the surface carefully, and transfer it to a deep vessel con-

taining water, the arachnoid surface being uppermost. Observe the velvety aspect of the lower surface, due to a fine pile of blood-vessels, and the very rich fringe of vessels along the intergyral folds, for the supply of the cortex deep within the sulci.

Seize with forceps one of these richly fringed folds and snip off a portion with a pair of scissors, floating it on to a glass slide, with its vessels disentangled and spread out. Remove also to another glass slide a portion of the membranes detached from the summit of a convolution, and study it by means of a hand-lens, both in reflected and transmitted light. Educate the eye in this manner into recognising the various healthy and morbid structures to be found here.

For microscopic purposes, both these slides last mentioned should be reserved, whilst a small portion of brain covered by its membrane, and including two adjacent convolutions, should also be set aside. These will afford subjects for a bird's-eye view of the surface under low powers of the microscope, such an examination being always insisted upon as especially valuable. The portion of brain must then be frozen and cut in such a direction that the sections so obtained represent both gyri with the intervening sulcus bridged over by arachnoid. We thus obtain very beautiful slides for fresh examination, which afford us the opportunity of minute examination of the cortex and the connections and relationships between it and its membranes.

The large superficial veins at the vertex where they open into the longitudinal sinus, are occasionally found plugged by thrombi; they should therefore always be examined with the object of ascertaining the nature of their contents, especially if there is evidence of inflammation of the dura mater and its sinuses, or of purulent meningitis.

The student should also take every opportunity of following up the arterial branches given off from the anterior, middle, and posterior cerebral arteries, in their course along the sulci, until he has familiarised himself with the exact supply of various regions and convolutions of the brain. It is only necessary to allude to the work of Duret and Charcot in this direction to indicate the importance of a minute knowledge of the arterial

districts of the encephalon in order to fully appreciate numerous lesions met with in the brain.

Nutrient Vessels at the base.—We should devote attention to the numerous vascular tufts which arise from the large vessels at the base for the supply of the central ganglia and pons Varolii. Those which supply the basal ganglia are disposed into anterior and posterior groups—the former arising from the anterior cerebral, anterior communicating and middle cerebral arteries; the latter taking origin from the bifurcation of the basilar, often from an enlarged posterior communicating, a further series arising from each posterior cerebral artery as it winds around the crura cerebri. Roughly, it may be stated that the anterior group supplies the corpus striatum and anterior extremity of the thalamus opticus, whilst the posterior group is distributed chiefly to the thalamus.

Note, first, their remarkably fine calibre considering their direct origin from main arterial trunks; and secondly, observe that they are given off from these trunks at a right angle—a significant fact, as they can only be affected to a minimum degree by the propulsive wave of blood caused by each cardiac systole. They are filled therefore by a sustained lateral pressure.

An examination of the nutrient supply to the pons will impress the student with the following facts:

1st. The nutrient twigs arising from the main artery are remarkably small, as in the other cases.

2nd. They also arise at right angles from the basilar artery.

3rd. The basilar is but slightly over half the capacity of both vertebral arteries which supply it.

The latter fact, which I have already demonstrated by measurement in our remarks upon arterial capacity, when taken in conjunction with the other two data warrants us in assuming that these nutrient branches are kept constantly filled by high lateral pressure and exhibit none of the phenomena of the pulse. I need not insist upon the beauty of this arrangement of means to an end. In removing the vessels at the base, be careful not to tear these nutrient vessels short, but with gentle traction draw them out and cut them across with fine curved

scissors; float the circle of Willis and its branches in a shallow dish of water, and examine the various nutrient groups. Snip off some of the anterior and posterior tufts, float them on to a slide, arranging the branches, and examine by the naked eye as well as by microscopic aid. Wherever arterial degeneration is suspected, never miss the opportunity of thus closely inspecting the nutrient supply of the corpora striata, optic thalami, and pons Varolii. The naked eye will suffice to reveal to us aneurismal dilatations along these branches, atheromatous degeneration, thrombi or embolic plugging, often explanatory of hæmorrhages within the structure of the basal ganglia or pons.

(*To be continued.*)

NERVOUS DISEASES IN VICTORIA.

BY JAMES JAMIESON, M.D., MELBOURNE.

THE question of the influence of climate in the causation of disease is a very difficult one; for this among other reasons, that it is hardly possible to eliminate with certainty social and other associated conditions. I am not prepared to say therefore that, in this contribution to the very obscure subject of the etiology of nervous diseases, much if anything has been done to make that influence plain. In itself, however, the subject is so important, and the data accumulated are so scanty, that the following statistics may be found to possess a certain value. The prevalence and fatality of nervous diseases in England have been discussed with great fulness by Dr. Althaus, in a series of papers in the 'Medical Times and Gazette' for 1876, afterwards reprinted with additions. I propose to give a somewhat similar, if less elaborate, discussion of the same points as regards the colony of Victoria. Before any comparison of the two countries is made with reference to the mortality from these diseases, certain things must be borne in mind by way of caution. Even now the population of Victoria has not the same composition as that of England as respects the proportion of the sexes and of persons living at different ages, and the difference becomes more marked as we go back to the time, nearly thirty years ago, when the discovery of gold brought so many immigrants to its shores. So great has been the change that it is not even easy to compare properly our own condition now with what it was twenty years ago, as tables subjoined will show. Social conditions too have altered greatly, and this could scarcely be proved in a clearer or more striking way than by the following fact. In

1854 there were no fewer than 70 deaths from delirium tremens, with a population of 312,000, while in 1878 there were only 16 among 879,000 persons, that number being also the average for five years preceding. The excitement and recklessness of the period, when the gold fever was at its height, subsided gradually, and must have had many other effects, though these may not be so easily established as those following the excessive use of alcohol. To these points, and to others which may suggest themselves, such as the mixed character of our population, gathered from all the ends of the earth, due weight must be given if any comparison is to be made of the results here given with those of Dr. Althaus.

I propose to compare the mortality in the two decennial periods, 1859–68 and 1869–78, thus bringing down our knowledge to the latest point, and going back as far as seems advisable in the peculiar circumstances. As preliminary to the others, the following tables supply some needful information about the population, taking the census years 1861 and 1871 as the basis. It would have been better if these could have been made the middle years of periods compared, but I have thought it advisable to give exact figures rather than mere estimates, which alone can be given for other years, and they at least afford an idea of the difference of the two periods.

TABLE I.

SHOWING THE NUMBERS OF PERSONS LIVING AT DIFFERENT AGES IN VICTORIA IN 1861 AND 1871.

	1861.	1871.
Under 5 years . .	91,514	116,688
5 to 10 „ . .	53,265	106,503
10 to 20 „ . .	67,652	140,131
20 to 45 „ . .	272,844	275,900
Above 45 „ . .	45,047	92,296
Total at all ages .	540,322	731,528

TABLE II.

SHOWING THE PERCENTAGE OF PERSONS LIVING AT DIFFERENT AGES IN VICTORIA IN 1861 AND 1871, AND IN ENGLAND IN 1871.

	VICTORIA.		ENGLAND.
	1861.	1871.	1871.
Under 5 years . . .	16·93 p. cent.	15·95 p. cent.	13·52 p. cent.
5 to 10 „ . . .	9·85 „	14·56 „	11·91 „
10 to 20 „ . . .	12·52 „	19·15 „	20·27 „
20 to 45 „ . . .	50·49 „	37·71 „	34·85 „
Above 45 „ . . .	8·33 „	12·61 „	19·43 "

Considering the smallness of the figures to be handled, I have not thought it necessary to subdivide more, and the distinction of infants, children, youths, adults, and old people, is sufficient. A gradual approximation to the English proportions is shown, but it is probable that even in 1878 differences were still very considerable. In the next table I have subdivided even less, both for the above reason and because up to twenty years of age males and females are about equal in numbers.

TABLE III.

SHOWING THE NUMBERS OF MALES AND FEMALES, AT DIFFERENT AGES IN VICTORIA IN 1861 AND 1871.

	1861.		1871.	
	Males.	Females.	Males.	Females.
Under 20 years .	106,874	105,640	186,507	185,932
20 to 45 „	190,603	92,185	169,159	114,435
Above 45 „	31,174	13,846	65,384	30,111
Totals at all ages	328,651	211,671	401,050	330,478
P. cent. of each sex	68·25 %	31·75 %	54·82 %	45·18 %

Even now males considerably exceed in number the females in Victoria, though, as is shown above, there has been a somewhat rapid approach to equality in the ten years.

TABLE IV.

SHOWING THE DEATHS FROM ALL CAUSES, AND THE COMPARATIVE MORTALITY FROM ZYMOTIC, TUBERCULAR, NERVOUS, AND RESPIRATORY DISEASES IN VICTORIA IN TWO DECENNIAL PERIODS.

	1859–68.	1869–78.
Zymotic diseases . . .	34,739 = 33·06 %	34,438 = 29·56 %
Tubercular diseases . .	10,820 = 10·29 „	12,558 = 10·47 „
Nervous diseases . . .	10,751 = 10·23 „	13,196 = 11·01 „
Respiratory diseases .	8,976 = 8·54 „	12,627 = 10·53 „
All causes	105,068 —	119,848 —

Of these four classes, that of zymotic diseases showed the most marked fluctuations, as might have been expected, while that of nervous diseases did not show very great variations from year to year. To some extent there was observable a tendency to the variations in the two classes of cases to follow a parallel course, the deaths from both being greatest in the three years 1860, 1866, and 1867, of the first decennium; and in 1875 and 1876, which were great epidemic years, the mortality from nervous diseases was also much above the average. This may have been accidental, as a similar concomitant variation does not seem to have been observed in England. While the mortality from zymotic diseases compared with the total is higher in Victoria, that from nervous diseases is distinctly lower than in England, averaging 10·64% in the twenty years 1859–78 as against 12 26%.

The great blot on these statistics is the largeness of the proportion of cases vaguely registered as "Disease," and it introduces a further difficulty, in addition to those already given, in the way of a proper detailed comparison of the mortality from particular forms of disease in Victoria and in England, where there has been more strictness shown. A few

TABLE V.

SHOWING THE DEATHS FROM THE SEVERAL DISEASES OF THE NERVOUS SYSTEM IN VICTORIA, AND THEIR PERCENTAGE OF THE ENTIRE MORTALITY FROM THE SAME CAUSES.

	1859–68.	1869–78.
Cephalitis	1694 = 15·75 %	2222 = 16·83 %
Apoplexy	1503 = 13·98 „	2593 = 19·65 „
Paralysis	664 = 6·17 „	1402 = 10·62 „
Insanity	89 = 0·82 „	65 = 0·49 „
Chorea	18 = 0·16 „	15 = 0·11 „
Epilepsy	324 = 3·01 „	562 = 4·25 „
Convulsions	3881 = 36·09 „	3514 = 26·63 „
Brain disease, &c. . .	2578 = 23·98 „	2823 = 21·39 „
Total nervous diseases .	10,751 —	13,196 —

words on the general results as regards each cause may be allowable.

I. *Cephalitis* appears to be a much more frequent cause of death here than in England, where the average for a long period has been only 6·64 per cent., with a slight but steady rise of late years. The difference between that figure and the Victorian average of 16·29 per cent. is very great, and is not to be accounted for by the different constitution of the population as respects age.

II. *Apoplexy* had become considerably more fatal in the second period, probably owing in great part to the greater proportion of persons above middle life, but it is curious to note that the percentage had become higher here than in England (16·19% average, maximum 17·85%), even though the number of old people was much smaller in Victoria, as shown in Table II.

III. *Paralysis*, for the same reason doubtless as in the case of apoplexy, caused a larger number of deaths in the second decennial period, differing from it in this important respect

that even in the second the percentage of mortality was still very much lower than in England, where it had been showing a rapid and steady increase (average 15·96%, maximum 18·11%). It is not easy to say with certainty, whether the higher rate in England is satisfactorily accounted for by the greater number of old people, or whether the tendency of disease to assume a more acute course, rather than to lead to chronic degenerative changes, in the dry stimulating climate of Australia, helps to bring about an apparently slighter liability to paralysis and other forms of disease usually dependent on structural degenerations.

IV. *Insanity* has been a less frequent cause of death in the last decennium, having fallen from 0·82% to 0·49%, or only about half of the English average. The figures for Victoria are so small, however, that, independently of other sources of difficulty, it is not easy to be sure that our average is a fair one. It at least does not show any tendency to an increase of mortality from that cause here.

V. *Chorea* here as elsewhere rarely proves fatal, and the mortality of the last ten years has been just about the same proportion as in England.

VI. *Epilepsy* has shown a very decided increase, and in the last ten years had become slightly more fatal than in England, where it has also produced a steadily higher death-rate. The difference between the two countries, however, is too slight to call for observation.

VII. *Convulsions*, here as in England, form the most frequent cause of death among the nervous diseases. The mortality produced by them is almost wholly among young children, and considering that these form a considerably higher proportion of the population here it might have been expected that the death-rate would also have been higher. Quite the opposite, however, has been the case, for while the average for a long period in England has been 48·70% of the total mortality, in Victoria it was 36·09% in the ten years 1859–68, and fell to 26·63% in 1869–78, or an average for the whole twenty years of 30·88%. I do not think that cases of death from convulsions could frequently have been registered under another term, not even under "Brain disease," the symptoms

being so unmistakable.[1] The only suggestion I can make in the way of explanation is the almost complete freedom from rickets of the children in this country, that disease, according to Dr. Gee, supplying the predisposition without which convulsions are either comparatively infrequent or at least seldom fatal. Though that doctrine has been accepted by Dr. Hughlings Jackson and others, it has been sometimes pushed too far, as by Dr. Hillier. My own experience is that convulsions are far from uncommon in this country, but that the exciting cause is almost invariably peripheral irritation, and in a large proportion of cases merely gastro-intestinal irritation resulting from the ingestion of unsuitable food. It may be that the relatively low mortality is owing to the absence of the rickety state of the constitution, so that recovery is easy, the exciting cause being removable, and essentially temporary in its action.

VIII. *Brain disease, &c.*—Whilst the large number of deaths registered in this vague way makes a comparison of the Victorian conditions with those in England less easy and exact, the proportions in the two decennial periods are so nearly alike that a comparison of these is not interfered with. The diminution in the second period is no doubt owing to more care in diagnosis, and perhaps to greater exactness being insisted on by the Registrar-General.

For the sake of completeness, something may be said about the influence of sex on the mortality from diseases of the nervous system.

It is unnecessary to make any extended remarks on this table (Table VI.); but it is curious to note to what a slight extent the mortality among females had increased in the second period compared with the relative increase in the female population.

[1] Though there could scarcely be any mistake about the existence of convulsions, there is some liability to error in the form of the registration certificate; and it is possible that some deaths, actually produced by convulsions, may have been put down as having their cause in "Dentition," that refuge of the man who is careless in his diagnosis. It may be said that there is the same possible fallacy in the English figures, and that a comparison therefore still holds good. Very many deaths have been registered as from "Dentition," in Victoria, no fewer than 3716 in the ten years, 1859–68. In the second period, 1869–78, the number was only 1881, so that even if strict account could be taken, the diminution in the death-rate from convulsions of late years in Victoria must be regarded as certain.

TABLE VI.

SHOWING THE NUMBER OF DEATHS AND PERCENTAGE OF MORTALITY FROM THE SEVERAL DISEASES OF THE NERVOUS SYSTEM IN MALES AND FEMALES.

FIRST PERIOD, 1859–68.

	Males.	Females.
Cephalitis	991 = 9·21 %	703 = 6·53 %
Apoplexy	1059 = 9·85 „	444 = 4·13 „
Paralysis	439 = 4·08 „	225 = 2·09 „
Insanity	62 = 0·57 „	27 = 0·25 „
Chorea	3 = 0·02 „	15 = 0·14 „
Epilepsy	177 = 1·64 „	147 = 1·36 „
Convulsions	2072 = 19·27 „	1809 = 16·82 „
Brain diseases, &c.	1629 = 15·15 „	949 = 8·82 „
Total nervous diseases	6432 = 59·83 %	4319 = 40·17 %

SECOND PERIOD, 1869–78.

	Males.	Females.
Cephalitis	1242 = 9·41 %	980 = 7·42 %
Apoplexy	1591 = 12·05 „	1002 = 7·59 „
Paralysis	887 = 6·72 „	515 = 3·90 „
Insanity	35 = 0·26 „	30 = 0·23 „
Chorea	4 = 0·03 „	11 = 0·08 „
Epilepsy	300 = 2·27 „	262 = 1·98 „
Convulsions	1898 = 14·38 „	1616 = 12·25 „
Brain diseases, &c.	1815 = 13·75 „	1008 = 7·64 „
Total nervous diseases.	7772 = 58·90 %	5424 = 41·10 %

The greater number of males above forty-five years counterbalanced the effect produced by the higher proportion of

females between twenty and forty-five years. The observation of Dr. Althaus, that males are more liable to die of diseases of the nervous system than females, is confirmed by the Victorian figures; for while 58·41 per cent. of the deaths from all causes occurred among females in 1859–68, the male mortality from diseases of the nervous system was 59·83 per cent.; and in 1869–78 the proportions were 57·44 and 58·90 per cent.

No account has been taken in the above tables of the deaths from tetanus and from delirium tremens. Tetanus finds no mention in our returns of Vital Statistics, and delirium tremens is classed with the zymotic diseases, though it might perhaps with some propriety have been ranked among those of the nervous system. Judging by the mortality it must once have been excessively prevalent in Victoria, as shown by figures given at the beginning of this article. The death-rate from it has, however, undergone a steady diminution, though it is still considerably higher than that of England.

TABLE VII.

Showing the Number of Deaths from Delirium Tremens, and its Percentage of Mortality among all Diseases of the Nervous System in Males and Females, and for both Sexes.

	Males.	Females.	Both Sexes.
1859–68 . . .	269 = 2·43 %	45 = 0·40 %	314 = 2·83 %
1869–78 . . .	153 = 1·14 „	40 = 0·30 „	193 = 1·44 „

These figures show a distinct and satisfactory improvement, though the lower averages are still above the English, which for 1867–71 were, males 0·55%, females 0·10%. In conclusion, I append a list of the various diseases arranged in the order of their fatality, and I have thought it best to take the results of the second period, when our population had got into something like a settled condition. If the total of the percentages is found to amount to more than one hundred, the explanation is to be got in the fact that the delirium tremens figures have been added after the others were calculated.

Convulsions	26·63	per cent.
Brain diseases, &c.	21·39	„ „
Apoplexy	19·65	„ „
Cephalitis	16·83	„ „
Paralysis	10·62	„ „
Epilepsy	4·25	„ „
Delirium tremens	1·44	„ „
Insanity	0·49	„ „
Chorea	0·11	„ „

This arrangement differs greatly from that given by Dr. Althaus for England, and I am sorry that it has not been possible to give a more definite account of the causes of the differences. I have endeavoured to apply tolerably complete data, and a little consideration will enable any one interested to see how great are the difficulties in the way of any such explanation.

A PLEA FOR THE MINUTE STUDY OF MANIA.[1]

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ANY ONE accustomed to the literature of general medicine, and turning to that of psychological medicine for the first time, must, I think, be struck by the comparative paucity of reports of cases in the latter, or at least of reports of cases intended to illustrate diagnosis, or the grouping of symptoms in mental diseases. True, in our special journals, and also in non-special journals, cases of insanity may, from time to time, be found described; but these are almost invariably published, because they illustrate the success or futility of some kind of treatment, or the morbid anatomy of some coarse lesion in the nerve-centres, and not because they are typical of any variety of psychical derangement. The records of cases indeed which are issued from lunatic asylums, whatever be the motive of their publication, are singularly deficient in information bearing on the modifications of the higher cerebral functions, and many of us would be puzzled at this moment, were we asked by any zealous student, to refer him to a series of clinical delineations which would convey to him a just conception of the nature and procession of the impairments of the senses and intellect, or perversions of the emotions and will, which correspond with the commonest forms of insanity. Perhaps the best and most vivid sketches we possess are those contained in a few of our text-books, and in the writings of some of the older authors on our subject, but even these have not always been taken from nature. Some of them commend themselves to us by their literary rather than their scientific

[1] Read in the Psychological Section of the British Medical Association Meeting at Cambridge, August, 1880.

merits, sacrificing, as they occasionally do, the angularity of a fact to the rounding of a period, and darkening knowledge by mere rhetorical flashes.

If we inquire the reason of this paucity of clinical reports of cases of insanity, we shall, I believe, find that it is to be attributed to several causes. In the first place, asylum medical officers have been called on hitherto to give so large a proportion of their time and energy to administrative, sanitary and routine duties, that they have had little left to expend on minute and tedious observations at the bedside or in the wards. Without clinical clerks, or with a very inadequate number, they have had to keep their own medical records, and have therefore confined these within narrow limits, and made them of an eminently practical character. Thus it has come about that the case-books of most asylums have been kept for official rather than scientific purposes, and do not afford the information that is necessary for the preparation of clinical reports. In the second place, the medical men who enter asylum practice are ordinarily unprepared by previous training to sift and classify the special phenomena that then fall under their notice, even if they had the leisure and disposition to do so. Unacquainted with the physiology of mind, they are bewildered by its morbid manifestations, and lack that knowledge of terms and those habits of thought that are essential to an accurate analysis of psychical derangements. In the third place, the observation of aberrations of mind is exceedingly difficult and laborious, even to those who are qualified for the task, and hence few have had the intrepidity to undertake it. And in the fourth place, the attempts as yet made in this direction have not proved of much real value, while their speculative interest has not served to secure perseverance in them. No practical benefit or guidance has seemed to accrue from anything beyond a vague and general survey of the mental condition in insanity, and so we have learnt to be content with comprehensive phrases, such as excitement, depression and incoherence, and have had little encouragement to draw up inventories of symptoms, which we invariably failed to connect with pathological changes.

And yet notwithstanding this deficiency of clinical records

of insanity and disregard of its psychical aspects, most of those engaged in lunacy practice have had to give considerable attention, in certain cases, to those mental symptoms in which alone, for legal and social purposes, insanity consists. In mania they may have attempted no analysis of the overwhelming disorder of mind, but in partial insanity they have been compelled to search out its weak points, and to ascertain in what respects it has departed from its healthy state. To do this they have had to practise what I shall venture to call ideo-diagnosis. They have had to stimulate by their ideas the mind which they desired to examine. Just as in testing the electric reactions of muscles and nerves we apply the electrodes at various points of the cutaneous surface, and note the results, so in testing the state of the mind we apply our ideas, as it were, at various points of its surface; we travel over it more or less systematically, gauging its ideo-sensibility and irritability as we go, and determining as best we may, whether and to what extent they are increased, perverted, or abolished. But what we travel over in this way, when practising ideo-diagnosis, is but a scheme of mind which we have constructed for ourselves. Doubtless our skill as specialists and expertness in detecting insanity, when it is latent or concealed, will depend in great measure on the thoroughness of that scheme and the ingenuity with which we pursue the researches to which it guides us; but even the most thorough scheme hitherto devised is artificial after all, and however it may help to establish the existence of insanity, will not aid us in that medical diagnosis which we should strive to attain to. For our scheme of mind does not harmonise with any scheme of brain, and our exploration is not conducted in accordance with our knowledge of cerebral topography; and hence if we come upon what is apparently a tolerably isolated patch of diseased mind, we are utterly incompetent to indicate the whereabouts of its pathological substratum. But it seems to me that standing as we do in the light of modern researches into the functions of the brain, we cannot be content any longer with this old style of ideo-diagnosis, but must work in all cases of insanity towards a localisation of the lesion, and a recognition of its nature. We must aim at an anatomical and

a pathological diagnosis, and these are only to be reached by a careful study of symptoms and of their mode of onset and associated conditions. We are perhaps far off any success in localising and characterising mental diseases, but the endeavour to do so should at least be made, and that it may be made, trustworthy, clinical records are a first requisite; and therefore it is that I put in a plea for the minute study of mania, which will, I think, yield to minute study results of great importance.

I take it as an established fact that there is localisation of function in the brain. I cannot here enter upon the proof of that proposition, nor is it necessary that I should do so, for I dare say we are all familiar with that proof and are agreed that it is complete and conclusive. We may adopt the view that the mental operations are dependent upon separate arrears of brain-substance, or we may hold that they are connected with distinct cell and fibre mechanisms existing in a more or less diffused and interblended manner, but in either case we arrive at what is practically localisation of function in the brain; for those who hold the latter view are obliged to admit that certain portions of the hemispheres are always and principally concerned in the carrying on of intellectual and volitional operations; that the fibres and cells concerned in the conduction and elaboration of sense impressions exist in maximum quantity in different parts of the surface of the cerebrum, and that certain definite portions of the brain are in some way related to the production of movements.

I take it also as an established fact that insanity is a disease of the brain which does not always involve the whole of that organ, but which, in a large majority of cases, is localised in certain regions of it. This hypothesis is necessary to the explanation of the innumerable varieties of insanity which occur, and is borne out by pathological observations as far as they go, and by analogy drawn from the affections of other organs. It seems certain that there are system diseases and focal diseases, neural and adneural changes in the brain, just as there are in the spinal cord, and that these are severally signalised, in the brain as in the cord, by distinct sets of symptoms.

But if there is localisation of function in the brain, and if

insanity, which consists in morbid modifications of brain function, is dependent upon local lesions, we ought to be able to determine with more or less precision the position of the brain-lesions, or of its functional derangements in certain cases of insanity. The inquiry must be an eminently difficult one, for reasons which need scarcely be enumerated, but still it must be undertaken if real progress is to be achieved in psychological medicine. By the diligent study of symptoms, of the modifications of motor and sensory conduction, of reflex action, of co-ordination and nutrition, various diseases of the spinal cord have been traced to their origin, so that we can now say with confidence, in many cases, that a lesion exists in a certain white or grey tract at a certain level. Is it not to be hoped that by an even more assiduous study of symptoms in connection with morbid anatomy, we shall yet be able, in cases of insanity, to define the particular territories of the brain that are involved in the morbid process? I think this is not only to be hoped but to be anticipated, and therefore it is again that I plead for a minute study of mania, which will probably conduce in no small degree to our knowledge of localisation in disease.

But it may be objected that mania is of all mental diseases that which is least likely to afford us help in an investigation of the cerebral condition corresponding with insanity. It invades, it may be said, all mental processes, is eminently complex, and probably depends upon a disorder diffused over the whole encephalon. These objections, however, admit of satisfactory answers, and it may, I think, be shown that next to general paralysis, mania of all forms of insanity presents the most favourable opportunities for the exploration of cerebral function in disease. We are not entitled to speak dogmatically as to the nature or distribution of the pathological changes upon which mania depends, but such evidence as we possess points to the conclusion that these often partake of the character of an erythema, and are not spread over the whole of the brain, but are limited to certain regions of it. Mania is of course a comprehensive term, and includes a number and variety of mental states, from mere transitory excitement up to the wildest fury, or the most chronic madness.

And with these numerous and varied mental states diverse conditions of the brain are doubtless associated; from a slightly heightened activity of the nervous arrangements in one or a few convolutions, with a trifling excess of the hyperæmia that accompanies ordinary functional activity, to widespread and intense capillary engorgement, or to the exudation of inflammatory products into the tissues. Fortunately we see but little of the morbid anatomy of mania, but when death does take place from exhaustion, or from some intercurrent disease during a maniacal paroxysm, the pathological appearances which we are most accustomed to find are engorgement of the vessels, hypertrophy of the brain itself, so that it expands, as it were, slightly on the opening of the skull, and vinous staining, due to capillary congestion of the grey and white matter—appearances, indeed, quite analogous to those which are seen in the skin when death has occurred during an erythematous inflammation of it. Now it is this vinous staining of the brain-substance that affords, I believe, a clue—an imperfect one, but still a clue—to the localisation of the cerebral disorder in mania, and that gives ground for the statement that even in fully developed and acute mania the whole brain is not involved. Whoever has carefully scrutinised this vinous staining will, I think, assent to the statement that it is not generally diffused, and that its most striking characteristic is, that in the medullary substance it occurs in scattered blotches. A very attentive examination of it in a number of cases has convinced me that in the cineritious substance, too, it is very unequally distributed, both in the layers of which the cineritious substance is composed and over its superficies. Although less patchy in the grey matter than in the white, this vinous staining is in the latter often confined to certain districts of the hemispheres or groups of convolution, and even occasionally to parts of particular convolutions. I have seen it strictly symmetrical in its distribution in the two hemispheres, and I have seen it much more marked in one than in the other, though never altogether confined to one. I have seen it pretty uniformly diffused over a large area of the brain, and I have seen it in distinctly isolated spots with tracts of normal brain-substance between. It is not suggested that

this vinous staining is the primary and essential change in mania, or that any connection between the symptoms of mania and the distribution of it has ever been traced out, or even between the severity of mania and its extent, and I refer to it not to argue that such a connection may be made out at present, but to indicate that the pathological conditions which subtend mania do not implicate the whole of the cortical substance of the hemispheres, a truth which I might also establish by showing that when the whole of the cortical substance is involved in inflammatory action, as is sometimes demonstrably the case in meningitis or encephalitis, a series of symptoms very different from those of mania is exhibited.

In order, however, to trace mania to its pathological seat in the cerebrum, and to render its symptoms instructive in connection with the localisation of morbid conditions, it is not requisite that we should be able to recognise its distinctive post-mortem appearances, if any such exist. To know clearly the function of a part, and to perceive in a diseased state a perversion of that function, is a sufficient justification for referring the disease to the part to which the perverted function belongs. And to know clearly the different functions of the different parts of a compound organ, and to perceive in a diseased state a perversion of certain of these functions while others remain intact, is sufficient to warrant the conclusion that the diseased state is partial in its distribution and involves only certain parts of the organ, leaving other parts exempt from attack. And so in mania, I maintain we may be justified in concluding without any assistance from post-mortem revelations, that the diseased state is limited to certain areas of the brain. During its progress certain functions of the highest nerve-centres are manifestly perverted, and these functions experiment is teaching us to regard as dependent on certain brain territories. A careful observation therefore of these perverted functions, especially when we can differentiate them clearly, will enable us to determine what brain territories are implicated by the lesions or functional derangements on which mania depends.

Now in mania the functional derangements which are presented to our observation are very numerous and of a highly

complex character. Disorders of all the mental functions, of volition, the intellect, the emotions, the propensities are displayed in a confused, inextricable, and ever-shifting mass, and these do not at present offer themselves to ready and immediate analysis. But besides these there are, I think, other functional derangements of the supreme nerve-centres, derangements of motility and sensibility which have not attracted special notice, but which will perhaps reward careful study, and afford insight into the pathology of the disease. I desire to call particular attention to the motor and sensory symptoms in mania, and to express my conviction that through a consideration of these we may attain to a greatly increased knowledge of its anatomical substrata.

The existence of motor and sensory symptoms in mania is obvious enough. Restlessness is almost indispensable to our idea of it, and every description of it that exists abounds with references to great muscular activity, contortions, gesticulations, violence, and wild cries. But these disorders of movement in mania have not been subjected to minute analysis. They have been regarded only as expressions of psychical exaltations, and as such have not been thought worthy of detailed examination. And no doubt many of the movements of maniacs are but unrestrained manifestations of ideal and emotional states, or reflexes of inordinate strength. But besides these movements there are others which, by their peculiarity and purposeless persistency, are marked out as being of a different character. And these it is which will probably, I think, be shown to depend upon excitation of the motor centres of the brain by a morbid process, and which will thus sometimes supply indications as to the parts of the brain involved in that process, and as to its lines of propagation and retrocession.

Even at the very height of acute mania, when the symptoms are infinitely complex and varied, certain markedly predominant movements may frequently be seen, which it is impossible to connect with any feeling or intention. Thus some maniacs will run about uninterruptedly night and day in a purposeless manner, and if held down in bed, will continue to move their feet and legs, as if still engaged in running. Others, again,

will remain in bed and rarely move their lower limbs, but will toss their arms about incessantly, or busy their hands unceasingly in smoothing or fraying the bedclothes. May we not suppose that, in the former class of cases, there is irritation of the postero-parietal lobule of the brain, in which Ferrier has localised the crural movements, and that in the latter class the irritation is concentrated in the ascending frontal and parietal gyri, in which the brachial and manual movements are localised. Some maniacs talk vociferously, and jargonise. May we not infer that in them there is an irritative lesion of the oro-lingual region in the third frontal convolution? Others are resolutely silent, but shake their heads from side to side without intermission. May we not suppose that in them the cortex of the superior temporo-sphenoidal gyrus is hyperæmic or inflamed?

It is not, however, in acute and fully developed mania, but in the milder attacks of the disease and in its initial stage, that useful observations of its motor symptoms may, in my judgment, be carried on. Mania may burst out at once without warning, or after a *stadium melancholicum*, in sudden completeness, but much oftener it begins in trivial deviations from customary habits of thought, feeling, and action, and attains its height by a crescendo movement. And, in the latter case, with the earliest mental wanderings come the muscular disturbances, which I regard as significant. These muscular disturbances, which may indeed precede the mental symptoms, or at least secure recognition earlier than they, are exceedingly varied in character; but I would mention, as amongst the commonest of them, fixed elevation of the eyebrows, producing a staring expressing of the countenance; habitual quivering of the upper lip, such as is seen in a child that is about to cry; twitchings of the zygomatici, rolling movements of the eyeballs, sudden clenching of the hands, and tremors of certain groups of muscles. I saw recently a case of mania in a youth in whom the malady was inaugurated by general restlessness, and a peculiar movement of the left hand. For two days before any mental disorder was apparent he brushed back his hair with his left hand every few seconds, in a rapid and abrupt manner. The movement was not habitual to him, and he

could only control it by a strong effort of will, and for a short period. Whenever his attention was withdrawn from the effort of control, the movement immediately commenced again with increased energy. In a case of recurrent mania in a lady, which I have had under observation with Dr. Ferrier, the return of the attacks of excitement is invariably announced by loud grinding of the teeth.

Now in such cases, and under such circumstances, it seems to me that the motor symptom perhaps betrays to us that region of the brain which is the starting-point of the vital irritation. Where there is grinding of the teeth at the outset of each paroxysm of recurrent mania, we might presume that the irritation, which afterwards spread over a wide zone of the cerebrum, had its centre and point of origin in or near the lower frontal gyrus. Where there is the sudden elevation and backward movement of the left hand, as in brushing the hair as a precursor of acute mania, we might believe that the upper part of the ascending frontal convolution of the left hemisphere is primarily at fault. And so where there are clenchings of the hands, twitchings of the cheeks, quiverings of the lips, rolling of the eyeballs, or elevations of the eyebrows, as preliminaries of mania, we might surmise that the ascending parietal, the ascending frontal, the superior middle frontal, or the angular gyri, were respectively the points of departure of the morbid process, or of one morbid process out of a series.

Next in importance to the observation of the earliest motor symptoms in mania, comes the observation of the order of succession of the motor symptoms as the disease advances, for this order of succession, if it could be ascertained, would disclose to us the line of march of the disease over a certain district of the cerebrum. Opportunities of making such observations in a trustworthy manner probably occur but rarely, but one such happened to me two years ago, and it was indeed this case, which I watched with Dr. Bucknill and Mr. Musgrave, that first impressed me with the extreme interest of motor symptoms of the kind which I am alluding to. A lady, aged 36, who had been depressed for a few days, suddenly became excited, restless, and talkative. For the

first few days of the excitement it was remarked that her eyes were very widely opened, and her pupils dilated. On the third day it was noticed that there were frequent sharp catching movements of the right hand, and these continued at intervals, sometimes at the rate of thirty per minute, until the fourth day, when it was remarked, the patient being then in bed, that there were constant flexion and extension movements of the right foot, or the ankle. On the fifth day, and for many days afterwards, the movements of the foot having ceased, there were incessant rhythmic waving movements of the right hand and arm. The left arm lay at rest, but the fingers of the left hand were constantly twisted, the middle finger being turned over the dorsal aspect of the ring-finger. Here it appeared warrantable to suppose that one arm of the morbid process had stretched along, during a period of three days, from the posterior end of the upper frontal convolution through the upper extremities of the ascending frontal and parietal gyri to the postero-parietal lobule on the left side, and had also run down the ascending frontal convolution, while on the right side the ascending parietal convolution was the only part of the motor area implicated.

It is not to be expected that cases of mania, with motor symptoms admitting of such a simple interpretation as has here been offered, will be frequently encountered. In most cases the motor symptoms are intricately complex, and are associated with voluntary emotional and reflex movements, in a way that defies all attempts at separation, and in few cases does the morbid process pursue a course determined purely by tissue continuity. It is probable that the irritative condition of the cortex is spread and propagated, in many instances, in accordance with the functional alliances of different parts, or with their vascular supply, and then of course it would be in vain to look for a succession of symptoms corresponding with the arrangement of centres in any region of the brain. Still it may be occasionally possible to obtain glimpses of the lines of invasion and retreat of irritative lesions through the motor areas of the brain through the order of succession of the motor symptoms, and that order of succession is therefore deserving of careful study.

But there are sensory as well as motor regions in the brain, and sensory as well as motor symptoms in mania, and a judicious investigation of these sensory symptoms will, in all likelihood, help us still further to understand the nature and distribution of the pathological conditions which underlie the maniacal state. Hallucinations of sight, hearing, taste, smell, and cutaneous sensibility, and impairments of sensory perception in connection with any of these, are difficult to identify and isolate. At the inception of a malady, however, certain retinal or Schneiderian or cutaneous projections may now and again be singled out, and then become the key to some of its secret recesses, opening up to our inspection, as it were, certain pathways of pathological inroad. As they are, however, purely psychical states, as opposed to physical symptoms, and as the statements of a maniac are rarely reliable, their existence is much more difficult to establish satisfactorily than is that of morbid motor phenomena. And even when they have been proved to exist, their interpretation is beset with difficulties. Bastian has pointed out, as I think with great justice, that the perceptive centres for visual and also for acoustic impressions, have probably a widespread seat in the cerebral hemispheres, while those pertaining to the gustatory and olfactory senses have presumably a more limited distribution. And yet, when we have in any case of mania distinct evidence of an optical illusion, or coloured vision, at the commencement of the attack, or persistently through the whole of it, I should be disposed to diagnose an irritative lesion, including incontinent discharge in the angular gyrus. And where, again, we have auditory hallucinations I should be disposed to diagnose a similar state of things in the superior temporo-sphenoidal convolution; then if in any case we found hallucinations of taste, or marked imperfection of that sense, with muscular movements of the lips, tongue, and jaws with those movements, in fact which are usually consequent on the excitation of the gustatory sensation, we might with propriety hazard the opinion that the middle temporo-sphenoidal convolution was the seat of morbid irritation. Where, again, we found hallucinations of smell, or of tactile sensibility, and these are by no means

uncommon in the early stages of mania, we should naturally refer these to lesions of the subiculum, and of the uncinate gyrus and hippocampus major.

And here it may occur to us that in our attempt to elucidate and connect the symptomatology and pathology of mania, we have overlooked the facts that there are extensive regions of the brain, the prefrontal lobes, which have yielded to experiment only negative results as regards both sensation and motion, and that there are grounds for believing that the centres for the highest mental functions are located in these lobes, and that in a large proportion of cases of insanity the essential morbid changes have their starting-point and home in them. But we are not left altogether without indications of the existence and progress of disease in it. I dare say we are all familiar with cases of mania which begin in a singular hebetude, or in a suspension sometimes sudden of voluntary and varied activity. The patient's muscular powers and sensation are unimpaired, he comprehends all that is said to him, and does not labour under any delusions or hallucinations, but he stands fixed and motionless, or performs any actions to which he may be urged in a stiff and machine-like way. His muscles are perhaps slightly rigid, and his whole aspect suggests that he is under a severe duress which checks all manifestations of spontaneity. He is, I should say, over-inhibited. But a little later a singular change has taken place in his condition. He is no longer statuesque, but restless. Hebetude has given place to animation, still without delusions or hallucinations; he is fitful and inconsiderate, being swayed inordinately by every passing impression that is made on him. He is incapable of concentrating attention upon any subject or of remaining at rest. He is now, I should say, under-inhibited. The highest controlling centres, which were in the first instance stimulated, have now become paralysed. In the first state they arrested the activity of the centres that are subordinate to them, and now their control has been withdrawn from these centres, which respond therefore in an excessive and extravagent manner to all appeals made to them. But the highest controlling centres are located in the frontal lobes, and the conclusion therefore is

that in cases of mania beginning in the manner just described, the disturbance of the cerebral cortex starts from that region. No doubt lesions in this large region of the brain will be followed by very varied assemblages of symptoms according to their position and extent, and the cases to which I have adverted illustrate only one mode of invasion of disease in this region. We shall most of us recognise, I fancy, in Ferrier's account of the effects of destruction of the antero-frontal lobes in monkeys an accurate portrayal of the first stage of mania in another and numerous class of cases. "I could perceive," he says, "a very decided alteration in the animal's character and behaviour, though it is difficult to state in precise terms the nature of the change. The animals operated on were selected on account of their intelligent character. After the operation, though they might seem to one who had not compared their present with their past, fairly up to the average of monkey intelligence, they had undergone a considerable psychical alteration. Instead of as before being actively interested in their surroundings and curiously prying into all that came within the field of their observation, they remained apathetic or dull, or dozed off to sleep, responding only to the sensations or impressions of the moment, or varying their listlessness with restless, purposeless wanderings to and fro."

My object in this paper has been merely to point out what appears to me to be a new and promising method of investigating mania, by a close observation of its symptoms in the light of recent researches into cerebral localisation. I could not within the limits assigned to it do more than indicate in a few instances the kind of symptoms that should be specially observed and the manner in which they may be translated into intimations of cerebral disease, and I have not therefore been able to make use even of the scanty stock of facts bearing on the subject which I have as yet been able to collect. If I am correct in believing that mania is immediately dependent on irritative lesions of the cerebral cortex which invariably involve the highest centres, but which very irregularly and unequally invade the sensory and motor regions of the hemispheres, then an abundance of facts will not

long be wanting to verify and illustrate the proposition and to explain away difficulties like that which presents itself when we remember that irritative lesions of those very centres which in mania we suppose when irritated to cause movements of the kind adverted to, in other conditions result in convulsions and chorea. It may be that the coincident involvement of the higher controlling centres in mania, and their exemption from participation in the irritative state in convulsions and chorea, accounts for the difference in the phenomena observed in these disorders, in all of which we assume the same motor centres to be morbidly irritated, or it may be that differences in the kind and degree of the irritative condition affords the key to the solution of the problem; but on such points we can only vaguely speculate at present, and until much careful investigation has been carried out.

But it may be demanded what advantage is to be secured by even the most detailed study of the movements, hallucinations, and thought-currents in mania? Supposing that all these had been traced to their starting-points in the brain—an altogether extravagant supposition—and that we were able to put our finger on the gyri in which the disorder originated in each case, what nearer should we be to its curative treatment, what reward should we reap for our patience and pains? It is not for me here to answer at any length such old-fashioned and short-sighted interrogatories, or to defend the acquisition of knowledge for its own sake even when that acquisition calls for protracted toil. All knowledge brings its own exceeding great reward, but not to those who pursue it in a purely mercenary spirit. But more than this; knowledge never fails to bring with it gifts that were not contemplated when it was sought. For a time it may seem to stand, solitary and useless, serving only as a monument of the ill-directed industry of him who quarried it and set it up; but in due season, as the building of the temple of science proceeds, the place is found which it and it alone can fill, and it becomes an integral and essential part of the goodly structure. If then an intimate knowledge of the phenomena of mania promised no immediate or practical return, it might still be pursued in confidence that

some unforeseen recompense would be bestowed on it. But even now some valuable fruits that may be gathered from that knowledge may be discerned. In the progress of pharmacology it has been established that certain drugs act specifically on certain centres in the spinal cord, medulla oblongata, and basal ganglia; and it is not too much to anticipate, when certain functional areas and centres have been satisfactorily differentiated in the brain, we shall soon be put in possession of means of modifying their activity and of arresting some of the disordered states into which they are liable to pass. Our experience of cannabis Indica, hyoscyamus, stramonium, belladonna, strychnia, chloral and other drugs, points to a preference and priority of action in each over definite cerebral tracts and regions, and a further experimental employment of these drugs, and of other therapeutic agents which will certainly be put into our hands, in the light of an enlarged acquaintance with cerebral localisation in health and disease, cannot fail to conduct us to conclusions of the utmost practical utility. Groping in the dusk as we do at present, we occasionally find our way in cerebral disease to the application of an appropriate and potent remedy. Walking in brilliant illumination, as we may perchance do hereafter, we should achieve such triumphs of our art, not occasionally, but habitually.

Critical Digests and Notices of Books.

Die Schrift-Grundzüge, ihrer Physiologie und Pathologie. By Dr. A. Erlenmeyer. 8vo. Stuttgart, Bonz & Co. (pp. 70, and 12 plates).

The first part of this essay is devoted to some physiological and ethnological considerations on the art of writing. We shall not follow the author into this portion of his task, but devote the space at our command to giving the reader an account of his views about the pathological changes observed in the handwriting of patients suffering from various diseases.

He divides alterations of writing into mechanical and psychical. In the former, which may be divided into ataxic and tremulous, the shape of the letters is interfered with; in the latter, included under the name of dysgrammatography, there are errors of orthography, grammar, and syntax. Dysgrammatographies fall under the headings of *conscious* (agraphy and paragraphy) and *unconscious* (writing in general paralysis of the insane).

The ataxic handwriting is characterised, like the ataxic gait, by the excessive execution of the movements necessary to the formation of single letters. Hence the up-strokes are carried on beyond their proper limits, the down-strokes are thicker and longer than necessary, the curves are angular and large, the letters of irregular size, the words do not preserve the straight line. Physiologically, this state of things obtains in the child's first attempts at writing; pathologically, it is found in cases where some central or peripheral lesion interferes with the due co-ordination of the various muscles involved in the act of writing. It is also found in cases of convalescence after grave acute disorders, such as typhus. It naturally supervenes in cases of sclerosis of the posterior cervical columns and in cerebellar diseases, and occurs "functionally" in the

condition of fatigue, and in intoxication, through alcohol and chloral.

Certain forms of writer's cramp give rise to ataxic writing, which, it must be added, does not always occur pure, but also in combination with the tremulous and paralytical types.

Tremulous handwriting is observed physiologically among old people, and consists simply of a wavy outline of the up and down strokes. In every other respect the writing is perfect. It is induced by cold, and by a variety of poisons, such as alcohol, morphia, chloral, nicotine, &c.; but as the author remarks in the case of alcohol, for instance, it is not when under its influence that the patient writes tremulously (he then writes ataxically), but when fasting. A small quantity of alcohol may even momentarily restore firmness to his muscles.

Tremulous handwriting characterises disseminated sclerosis, and also occurs as an element in many cases of general paralysis. The author is not able to say whether the difference in the characters of the tremor in the former disease and in paralysis agitans manifest themselves by their respective handwritings.

Experimental proofs of the implication of the various muscles involved in the act of writing can be readily obtained by localising an interrupted current of electricity in each of them on a healthy subject. A clear notion is thus gained of the difference observed between vertical and lateral tremor; the former is due to implication of the musculo-spiral group of muscles only.

Under the heading of psychical disturbances of handwriting, the author includes agraphia and paragraphia. Much the same considerations which arise in the case of aphasia obtain also with reference to agraphia. This may be amnesic or ataxic. But the author insists on the distinction between true paragraphia, the subject of which is conscious of his not writing correctly, and the paragraphia of the general paralytic, who shows no such consciousness, but is perfectly satisfied with the nonsense he may be writing.

The author discusses and illustrates the following propositions with reference to "paralytical" writing. It occurs only in presence of a diffuse cortical lesion. It is characterised by

excess or deficiency: necessary elements of language (letters, syllables, words). It appears very early in the disease, and may then be a valuable element in the diagnosis.

With the progress of the lesion it becomes associated with the mechanical disturbances previously considered. The author particularly insists upon the diagnostic importance of a careful examination of the handwriting in the early stage of suspected general paralysis, and shows by example how it may be of assistance in doubtful cases. Another important point is, that in those cases where a syphilitic process is at the root of the evil, and where an appropriate treatment is being successfully pursued, the first symptom of improvement is given by the restoration of correct writing. The comparison between handwritings collected at different periods of the disease is in all cases the easiest way to estimate the progress the patient is making for better or for worse.

The author gives an instance of the temporary benefit derived from galvanisation of the brain in general paralysis. Under the influence of the current there is an improvement both in the mechanical and psychical abnormities of the handwriting, and it is to be noted at the same time that the patient writes more rapidly than before. He adds, however, that he has never derived any permanent results from a systematic application of galvanism in cases of general paralysis.

Dr. Erlenmeyer illustrates his essay by means of a series of facsimiles of well-chosen examples, and deserves all credit for having led the way in the attempt of giving a systematic account of the pathology of handwriting, and opening up a fruitful field of study to the clinical observer.

A. DE WATTEVILLE.

Brissaud on Hemiplegic Contracture. 'Recherches Anatomo-Pathologiques et Physiologiques sur la Contracture Permanente des Hémiplégiques, par E. Brissaud. 8vo. pp. 206. Paris, 1880.' (Publications du Progrès Médical.)

IN this able and instructive monograph, highly worthy of the distinguished Salpétrière school of neuropathology, M. Brissaud

discusses the morbid anatomy, clinical features, and physiological pathology of hemiplegic *contracture*.

Hemiplegic contracture, secondary degeneration in the spinal cord, first signalised by Bouchard, and cerebral localisation, being all intimately related questions, it is necessary in the first place to consider the anatomy, normal and pathological, of the internal capsule and pyramidal strands, and the connections of the latter with the cortex on the one hand, and the spinal cord on the other.

The pyramidal strands are to be considered as connecting the motor regions of the cortex cerebri with the multipolar cells of the anterior cornua of the spinal cord. They pass through the internal capsule and cerebral peduncle, decussate more or less completely (occasionally not) at the lower anterior aspect of the medulla oblongata, and then descend in the posterior part of the lateral column, gradually diminishing in their progress until they almost disappear at the lumbar region. The non-decussating strands descend in the antero-internal column of the same side intimately related to white commissural fibres which probably connect the pyramidal strands with the lumbar region. There is no good ground for supposing with Huguenin that the pyramidal strands form a direct connection between the cortex and the muscles; but rather that they are commissural between the cortex and the motor cells of the anterior cornua.

Bouchard first indicated the relation between secondary degeneration and lesions of the internal capsule; but Charcot first clearly differentiated the effects of lesions of different parts of this structure. In 1875 the anterior two-thirds of the internal capsule were regarded as belonging to the motor region, and the posterior third to the sensory paths. But the researches of Flechsig in particular, founded specially on the developmental anatomy of the brain, have considerably circumscribed the area of the internal capsule directly connected with the motor regions. On horizontal section of the hemisphere (which displays the form of the internal capsule better than the vertical sections of Pitres) the internal capsule is seen to be formed of two segments: an anterior, directed forwards and outwards, and bounded by the caudate and lenti-

cular nuclei, internally and externally respectively; and a posterior division, directed backwards and outwards, and bounded by the optic thalamus and lenticular nucleus. The point of union of these two segments is termed by Flechsig the *knee* or *genu* of the internal capsule. From Flechsig's researches it appears that the motor regions of the cortex have no relation with the anterior segment, nor with the posterior third of the posterior segment, but only with that portion intermediate between these two. But though it would appear that the pyramidal fasciculus is confined to this portion, yet secondary degeneration may occur in the internal capsule outside this area. This is the first point on which M. Brissaud gives the results of his own investigations.

Secondary degeneration when it occurs is most evident in the inferior aspect of the cerebral peduncle. When this is carefully examined it may be differentiated into three fasciculi. These, again, are divisible as follows:—

1. A posterior or sensory fasciculus which, according to Meynert, passes into the occipital lobe. This is never the seat of secondary degeneration.

2. A middle fasciculus, which is the most common—and which has usually been considered as the sole—seat of secondary degeneration. This contains the fibres conveying volitional impulses to the trunk and limbs.

3. An internal fasciculus, which has long been regarded, but erroneously, as incapable of degeneration. This fasciculus is of small dimensions, and may be termed the "geniculate fasciculus," as it is connected especially with the "*genu*" of the internal capsule. This fasciculus contains motor fibres which are distributed to bulbar centres, and specially move the face, the tongue (perhaps also the soft palate), and in general all the parts of the head and face capable of volitional movement.

4. A fasciculus (internal to the preceding) which also terminates in the bulb, degeneration of which does not seem to be associated with other than intellectual disorders.

When these four fasciculi are examined in their relations with the different portions of the internal capsule, it appears that—

1. The posterior fasciculus corresponds to the posterior third

of the posterior segment. This is the region of hemianæsthesia.

2. The middle fasciculus corresponds to the anterior two-thirds of the posterior segment—the pyramidal fasciculus.

3. The geniculate fasciculus corresponds to the genu of the internal capsule, and is in direct connection with the third frontal convolution or inferior extremity of the ascending frontal.

4. The internal fasciculus corresponds to the whole of the anterior segment of the internal capsule.

Various cases are detailed illustrative of these generalisations, which if substantiated in all their precision by succeeding research, must be regarded as a great stride in structural and functional localisation.

In the spinal cord the degeneration affects the lateral column, the same tract as is primarily invaded in amyotrophic sclerosis. But as the pyramidal strands end in the cells of the anterior cornua, it thus becomes possible for degeneration of these strands to extend into the cornua and lead to atrophy of the cells with its consequences—muscular atrophy. That muscular atrophy may occur in connection with hemiplegic contracture has long been maintained by Charcot, and Brissaud adduces evidence both from the descriptions of older observers, such as Todd, and from recent cases, to show that muscular atrophy is much more common in connection with hemiplegic contracture than is generally supposed.

In the cases in which this has been found, there is marked diminution of the anterior cornua of the paralysed side, and the large cells greatly diminished in number, or entirely gone. Those which remain show evident signs of degeneration. The cell groups most commonly affected are those in the anterior extremity of the cornua. The gelatinous substance surrounding the cells is also altered and atrophied. The cells of the intermedio-lateral tracts are also frequently invaded by the atrophic degeneration. As in the case of the white columns, the atrophy is most pronounced in the cervical region, occupies less extent in the dorsal region, and is scarcely visible in the lumbar region.

Hemiplegics have been usually divided, according to Todd,

Duchenne, &c., into two great classes, viz., those with, and those without contracture. These latter, however, when the hemiplegia is incurable, are comparatively rare, and it is doubtful whether they ever occur without a disposition to rigidity, characterised by exaggeration of the tendon reflex and spinal trepidation. Hence Brissaud would reject the category of permanent hemiplegia without rigidity, and term it hemiplegia with *latent* contracture. Hemiplegics are frequently met with who have apparently recovered and escaped the usual contracture, and who nevertheless are incurably paralysed. Several cases are related of this order in which the limbs, otherwise flaccid, are at once excited to contracture by a tap on the tendons. They are in a state ever ready to exhibit contracture, though not permanently rigid. In the same way that spinal reflexes excite spasm, so do volitional impulses, emotion, &c., excite the same. In hemiplegia with contracture, permanent or latent, the phenomena of *associated movements* are frequently observed, i.e., a propagation from the sound to the paralysed side, and *vice versâ*. Thus in a case of right hemiplegia with latent contracture, closure of the left hand excites the same action in the right, and when repeated several times in succession gives rise to actual contracture of the right hand. In another case, left hemiplegia and slight contracture, closure of the right hand increases the contracture on the left. In this case also closure of the left hand by itself is not possible until the movement has been first initiated by the sound hand. Similarly also, as Déjerine has shown, there is often a propagation of spinal trepidation from the paralysed to the sound side. In fact, as will be seen subsequently, the condition as to reflexes in the sound side of a hemiplegic is never quite that of a normal individual.

It is not merely as regards contracture and its allied conditions that there is a passage from one side of the cord to the other. It is possible for a paralytic condition to extend across to the sound side. There are in the wards of the Salpétrière a great many hemiplegic females who after a certain number of years have become paraplegic, with rigid flexion and immobility of the limbs. These cases are no doubt to be explained by a transverse extension of the sclerosis.

Another transformation of hemiplegic contracture is a return

to the state of flaccidity. This coincides with the setting in of muscular atrophy. This may occur at a variable period, and is most marked in the shoulder, and thenar eminence. It is not to be confounded with mere wasting from disuse; when it sets in the contracture gives way, and the tendon reflex diminishes or disappears. The muscles which become atrophied are frequently the seat of acute pains, which coincide with the atrophic degeneration.

A special chapter is devoted to the description and investigation of the "signe du tendon," or what is very commonly called tendon-reflex. On the setting in of hemiplegic contracture the patellar tendon reflex becomes exaggerated. Changes also occur in the time, amplitude, duration, and form of the contraction.

Brissaud's measurement, determined by a careful method which he describes and figures, of the normal time is somewhat higher than that given by Tschiriew. Tschiriew gives 32 to 34 thousandths of a second as the interval between the percussion and contraction; whereas Brissaud puts it at from 48 to 52 thousandths. Gowers' measurements, 0·09″—0·15″, are not regarded as accurately made. If we take 50 thousandths of a second as the mean, we can only take it as an average, as the tendon reflex is liable to variation from numerous causes. But the chief point is that in the normal individual the two sides are alike in this respect.

The amplitude cannot be determined absolutely; the duration of the contraction is usually from one-third to one-half second; and the form of the contraction is like the ordinary muscle curve.

In hemiplegic contracture the time of the reflex on the paralysed side is diminished, usually by 4 to 5 thousandths of a second, as compared with the sound side. But it also appears that the so-called sound side is not actually altogether normal. For while the normal average is, as already stated, 48 to 52 thousandths, in the sound side of a hemiplegic the average is between 38 and 42. This fact throws light on the mechanism of associated movements and other phenomena above described.

The contraction is also more brusque, and the duration is

also greater, as is readily apparent on comparing the cases with each other. The duration of the contraction is not unfrequently double that of the normal, and the lever often shows dicrotic or polycrotic curves in its descent.

Another point in reference to the tendon reflex is that, though percussion of the ligamentum patellæ is not at all painful, yet, if frequently repeated, it gives rise in the normal individual to a peculiar sensation, difficult to describe or define, but which is felt in the lumbar, dorsal, or even cervical region.

In hemiplegic contracture this is very marked, and has almost the character of an *aura* running up the dorsal region to the throat. In fact, an epileptiform convulsion may result, as illustrated by a case under the care of M. Debove.

The state of contracture may be characterised as a state of *permanent muscular activity*. This is shown by the giving way of the contracture when the limb is rendered exsanguine by Esmarch's bandage applied for about twenty minutes, except in cases where the contracture has resulted in deformity of the articulations.

With respect to the attitude assumed by the limbs, viz., flexion with pronation of the upper extremity, and extension with adduction of the lower extremity, various hypotheses have been advanced to account for it. But experiments with strychnine show that the attitude assumed in the tetanic spasm is not due to the action on one set of muscles only, but is merely an exaggeration of the normal muscular tone; and the condition is precisely the same in contracture, the position assumed being that of equilibrium between the flexors and extensors, constituting, as Charcot terms it, a *spontaneous strychnism*.

Among theories advanced to account for contracture have been encephalitis or myelitis; removal of the inhibitory influence of the cerebrum; peripheral neuritis; associated movements, all of which are more or less inconsistent with the real facts. The contracture is most satisfactorily accounted for on the hypothesis of irritation of the cells of the anterior horns by the secondary degeneration in the pyramidal strands of the cord, an explanation which harmonises best with the other conditions in which contracture manifests itself, as in strychnism, primary lateral sclerosis, or contracture dependent

on transference of sensory irritation, as sometimes occurs in tabes.

The contracture lasts only so long as the cells of the anterior horns are intact. When they degenerate the contracture ceases, and the muscles atrophy.

Looked upon as an exaggeration of the normal tonus, contracture may be considered as a kind of permanent reflex contraction, like tetanic spasm, but less violent, and more persistent. The equilibrium which characterises the hemiplegic contractures is liable to variation under various influences. Thus emotion increases it, so also electrisation, as Duchenne has shown. They all have the effect of increasing the excitability of the spinal centres. Strychnine increases it very markedly. Among other causes also deserving special mention are traumatic injuries, especially about articulations, whereby the nerves specially calling forth muscular contractions are irritated. Hysteric contractures have essentially the same characters.

Latent contractures depend on a hyperexcitability being maintained by a process of degeneration not extensive enough to set up the state of contracture, except on further provocation.

In a similar manner we may explain the occurrence of irregular movements of the type of athetosis which are often observed in limbs not entirely paralysed. During the waking state the muscles are never allowed to be absolutely at rest. The contraction of one excites others reflexly, and so the limb is in a constant state of movement. The spasmodic tendency in these cases is mostly dependent on lesion high up, in the lenticular nucleus or of the thalamus, and in immediate contiguity to the internal capsule.

As regards the physiological condition of muscles in a state of contracture, it has already been shown by the Esmarch bandage that the state is one of activity. Yet it is not contraction, for a contractured muscle can be made to contract by stimulation. The condition is one intermediate between flaccidity and contraction. The state of repose is a state of tonicity, not of flaccidity, and therefore as tonicity does not induce muscular fatigue, we can understand how the prolonged exaggeration of this tonicity does not cause any evident

fatigue. But one would expect in the state of contracture the chemical and physical phenomena which accompany contraction, though in a less degree. Among these are two which Brissaud has specially investigated, viz., the muscular bruit, and the generation of heat. The bruit of the *contract-d* muscle is regular, sonorous (*bruit rotatoire*) and constant in the number of its vibrations; that of the *contractured* muscle is feeble, irregular, and jerking, with interruptions and intermissions. The muscular fibres seem, instead of contracting regularly and simultaneously, to follow each other and to act with different degrees of strength.

The contracture ought according to theory to be accompanied by development of heat. On this point Brissaud has had the aid of Regnard in his investigations, but so far as they have gone the facts seem contrary to their expectations.

The contractured muscles of hemiplegics are in reality always of a lower temperature than those of the sound side. The difference is slight—several tenths of a degree—but constant.

They endeavour to explain this by the heat generated in the sound side through the movements requisite to place the patients under the conditions necessary for investigation, continuing some time, and thus vitiating the comparison. And they are of opinion that the comparison could only be accurately made during sleep, which is practically impossible.

But it may be suggested that the result could be arrived at notwithstanding these difficulties. It is quite possible for the contractured muscles to be of a lower temperature than those of the sound side, and yet be higher than in the state of flaccidity. Hence comparative experiments on both limbs before and after the influence of chloroform, which causes the contracture to give way, ought to afford a simple solution of the problem.

In addition to the facts and arguments contained in the body of the memoir, of which the above is a *résumé*, M. Brissaud appends the details of numerous illustrative cases. The subject of which he treats is one of the utmost importance in neuropathology, and the ability with which it is handled is worthy of the highest commendation.

DAVID FERRIER.

Scientific Transcendentalism. By D. M. London: Williams and Norgate. 1880.

THE title of this work will probably be considered by many minds to be somewhat anomalous; for "Transcendentalism" is too often thought to be beyond the region of science altogether, and not to differ much from whatever is impossible or absurd; and, at any rate, it might be incongruous to attempt to apply the method of one department of knowledge to that of the other. After all, the difference is very likely only one of degree, and that party may by no means be the only one entitled to certainty, which endeavours to secure it by adhering rigidly to nature in the concrete form, and never using the intellect, save as a rake to collect what lies upon the ground. Of course there is no need here to discuss whether a science of metaphysics is possible, and to do so would involve opening the aged question of Idealism *v.* Materialism. But even ultra-materialists may be induced to abate their scorn by the sight of the precision—even mathematical—with which our author gives sensible proof of his intentions, unless they suspiciously regard it as a snare laid by the Evil One to entrap the truthfully pure: moreover, the volume is so small (pp. 113), that it cannot repel the most dainty appetite on that score. But, lest readers should fancy that the sole attraction of the book consists in the establishing of a system of Ontology, we desire to call attention to another feature, which might not be looked for, as it is not so very often to be met with in works of this class, and which makes this one a valuable object of study—even in medicine as well as psychology—as well independently, as from its bearing on the special contents of the work; we refer to the account given in the introduction of the singular genesis of the doctrines here set forth, and which makes the work an important contribution to the psychology of mysticism; and if readers care not much for the picture these doctrines form, they will assuredly do so for the canvas on which this picture is painted.

This preliminary chapter occupies a considerable portion—nearly one-fourth—of the whole; it commences, as might be expected from a professed Transcendentalist, with a reproving

criticism of the claims of modern science, on the ground that, though a large accumulation has been made of late of material facts and inductions therefrom, and therefore "careless persons are in danger of believing that nothing more, or not much more, remains to be discovered;" yet nothing whatever has been gained in the department of mind. But there are always some, and our author is one, who are too deeply convinced that a science higher than physics and chemistry really exists, and that the method of intuition is to be relied on. Now, if it can be shown that the canons of ordinary science are equally applicable to the superior field, the certainty allowed to the former may be extended to the latter; this D. M. claims to lay forth. In order to be in possession of a universal theory, he will not attach himself to the position of common Transcendentalists, who believe in the dependence of phenomena on a Person of Infinite Power outside the universe subjecting it to moral guidance; but fully acknowledges the objections of materialists that this fails to account for the laws of matter, however well it might explain those of mind. Thus, the Materialist and Transcendentalist theories both contain much, but not the whole truth: will not the adoption of the plan of theorising in common experience lead us up to the greatest theory? Now, this process consists in seeing a resemblance between a new unknown and that which is already known; the Transcendentalist, therefore, has to assimilate matter to mind, the Materialist mind to matter. Here, then, lies the problem of philosophy, to resolve the two into unity.

So far we meet with nothing extraordinary; however improbable a fantasy such doctrines seem, they are at least to be found in cool prose from hundreds of other sources. But may we not be assured that the tones proceed from Bedlam, if not from the sepulchre, as he unfolds, on pp. 6–7, the amazing tale of his escape from the prison-house of sense? We may advantageously quote a paragraph or two in full:—

"Four years ago nothing was farther from the mind of him who writes these lines than the desire of becoming an author of books, a man of science, or a public theorist on any subject whatever. He was then in the service of a banking company in the interior of South America. He had a taste for modern

languages and comparative philology; read the Bible, Plato, Shakespeare, and Jeremy Taylor; taught the Gospel of Jesus Christ in the Sunday School; and tried to do his duty, as far as he knew it, in the least offensive way. He had acquired the, in that country, contemptible character of 'hombre sin vicios,' which it was part of his creed to maintain.

"One morning, however, this quite commonplace individual awoke to find himself possessed of a curious power of inventing allegories or parables on all sorts of moral and metaphysical subjects. Conceptions chased each other through his imagination like dissolving views. Occasionally a brighter image than the rest would stay long enough to be described: it would float before the eyes like a fairy scene in a pantomime, blotting out a large surface of the earth for a time; but usually the figures succeeded each other too rapidly to be described even in shorthand, and at times they melted together in one long train of shapeless delicious emotion."

Now, can it be a "spirit of health," and not a "goblin damned," that comes in such a questionable shape as this? Disbelievers in revelation, who are unable to recognise its true nature by the light of psychology, will doubtless summarily reject the whole of the proffered news, and return to the messenger the answer which Festus gave to St. Paul. This we would affirm to be hasty, notwithstanding the suggestion conveyed by the information that "these inspiration-fits were of almost daily occurrence, and lasted from one hour to four or five hours," during which periods he "let the 'spirit' have its fling." He preserved a remarkably praiseworthy attitude, however, towards the phenomena; not believing that the "spirit" was any god, angel, or genius, but determined to devote all the time he could spare to study the matter with care, and for this purpose came to Europe and spent many months reading and meditating in seclusion in Paris.

The case just related is, indeed, a curious one, and we only regret that the facts furnished – especially of collateral evidence—should be as scanty as they are; were we to adopt the logic of chance, and count rather than weigh individually the members of the class to which the author's intellect belongs,

there might be little reason to rest dissatisfied with the first surmise that the story suggests, viz., that the periodic inspiration is only a peculiar form of epilepsy; and that having such a morbid foundation, it must be thoroughly impregnated with error, and must therefore give way, involving us in its destruction if we trust to it. We think, however, that this decision is not inevitable, but that after all it *is* an honest ghost that thus addresses us.

Next to actual disease, the cause next in probability would perhaps be some pseudo-disease, such as the influence of some drug, such as alcohol, opium, or haschisch; but the history of the case would persuade us to exclude any of these.

Is it, then, possible that the normal agency of the imagination can produce a state so closely bordering on delirium? A similar bounding state occurs, we know, in "the lover and the poet," within the range of health, as well as in "the lunatic;" but there are still other conditions, with which perhaps the Duke of Athens was unacquainted; perhaps the study of pure philosophy may be one, but certainly and chiefly the warmth of religious emotion cannot be passed over; for in this respect all prophets, oracles, and mystics attain, in their search for righteousness, an exaltation in nature similar to, but as much more lofty in aim than, the poet in his search for an ideal of humanity in nature, as the poet excels him who has only the common aims of action. And if, by a process of deduction, we are inclined to place our author within this class, his right to be there will be greatly strengthened by confirmatory *à posteriori* evidence; and this, we think, can be brought forward. The journey to arrive at our author's intellectual state is no less than an ascent of Olympus; and perhaps he will appear to have performed it on wings rather than on foot; but still can we not feel sure that he has only travelled along the ordinary path. It is hard to believe that such a mature intellectual product can have been formed quite unconsciously and delivered without any of the pangs of labour; but is not the account—meagre as it is that is given of his character habits, tastes and studies, a just description of what would be most likely to engender such an offspring? and that

the delivery should come suddenly and unexpectedly is not after all surprising, for it has been paralleled if not surpassed in abundance of recorded instances—notably in that of Jacob Böhme; and "unconscious cerebration" is unfamiliar to none. Still the question remains why the mind should make such upward reaches at all; and it is here, perhaps, that the analogous cases consequent on disease may afford some help; for such mental enlightenment is often a prominent feature in morbid psychology; it may be as well to note that this opening of the eyes does not imply an enlargement of the mind, being rather an analysis of the tissue of the mind—a separation of its web into its constituent fibres than a positive increase of mental substance. That it should occur in states of mental weakness (not loss), when the resistance is disproportionately large as compared with the power to overcome it, suggests that it may be a sort of compensatory process, perhaps an attempt to commence hypertrophy; and probably the plasticity induced by disease increases the facility for undergoing analysis. It would be interesting to know whether, in the case under consideration, there might not have been just a tinge of disease, showing itself, perhaps, by a slight degree of melancholia, sufficient to give some increase of plasticity. This seems to us to give some explanation of the reflectiveness of Hamlet, as well as of the illumination often occurring in epilepsy; but still there may be many other modes—perhaps an inverse one also—of the connection of genius with insanity.

In continuing his history, our philosopher tells us how, after much writhing in study, order at length began to show itself instead of the previous confusion; and his fully formed ideas burst their last adhesions. His train of thought was something as follows:—The subject-matter is mental, yet the vision is material; how can these, which are so opposed, be reconciled? He becomes convinced that the identity of mind and matter is real: it is acknowledged on all hands: do not all men—the vulgar as well as the inspired—speak of mind in terms of matter, as if it were endowed with size, motion, expressions, and other simple properties? On the other hand, there are undoubtedly differences—possibly only superficial—resolvable

essentially into these:—Matter is extended and dynamic, mind unextended and seemingly powerless: the difficulty of power disappears at once on reflection; for are not wishes, ideas, and feelings *motives?* The other fares no better, for extension is but externalisation, and this is only apparent, for at bottom what is extended consists of states of consciousness, as well as mind: perhaps, then, in time the mental world may expand into an analogue of the material world. Thus the grounds for separation disappear. Deferring, for want of light, the question of causal relation between them, he proceeded to ascertain *why* mind was described in terms of matter, and concluded that it was because the latter was the more familiar, just as less known material phenomena are described in terms of the more known: and if it is so difficult to describe material phenomena (e.g. geography, history) perfectly, how much more imperfect must our mental knowledge be without inspired vision! Common mental knowledge, then, could be much improved by adoption of an improved system of symbols, and this (which he obtained by inspiration) he purposes to give. For, though he admits that many a mystic before has had sufficient mental knowledge, the expression of it has been prevented for want of more complete material knowledge—mystics as a rule being ignorant of, and indifferent to, common science. Admitting that even inspired vision gives but fragmentary perception of the assimilation of mind and matter, he holds that as they resemble each other in some degree, there is reason to believe they do so in all. His keenest perception of this identity, the homology being complete, was that of observing a peculiar formative principle—best known as life—actuating both; thus each is an organism. Nearer the truth than this animistic philosophy it seems to us impossible to go. Thus mind as well as matter is governed by inherent impersonal laws: the difference is one of degree: one is much consciousness to little substance, in the other the proportion is reversed. Mind is what matter has been, matter what mind will be. (Here he states the doctrine of evolution, but from an idealistic point of view). Having now attained the climax of his knowledge, he paid his attentions to the lower regions of physical science, to verify his material conceptions, and apply these material laws

and their vocabulary to mental phenomena, as if by geometrical superposition. Nothing then remained but to give expression to his theory: he apologises for its rough style, which certainly exists, and there is not freedom from ambiguity, but this perhaps does not extend much below the letter. He claims excuse on the ground that the "moral law has never before been made a subject of exact demonstration from common experience," which we think can scarcely be allowed while Spinoza's Ethics is in the memory.

But we must give a short outline of his exposition; it is divided into chapters more or less dependent. The first is upon the Fallacy of Language—in which he assails, first by induction then by deduction, the current "rhetorical theory," that language, being such an imperfect symbol, can convey actual knowledge: at first, disproportionate space appears allotted to this subject, but the object seems to be to emphasise the fact that a thing and its symbol are not identical.

Next is set forth the Essentials of Logic; but this plan seems to fall short of what we should expect of a "system of logic from the vitality standpoint," which would suggest something more Hegelian than the Associationist theory on which it is chiefly based; it is rendered as precise as possible by the use of geometrical diagrams. "Substance" is declared to be the essential attributes of a system. Abstraction and conception are then treated in more detail: causation is resolved into invariable succession. Some specification of the theory is carried out in a list of definitions, and various corollaries in the form of notes.

The author's opinion has now become decided as to the causal connection of mind and matter, stating definitely that the former is the invariable antecedent. This is proved by the incontrovertible intuition of the mental source of human expression; now as human acts are identical with not-human acts, the latter also must own a mental source. He is careful to avoid the error of anthropomorphism by showing that that crude doctrine arises from imperfect abstraction of "soul" from "human soul." He seeks confirmation in the etymological opinion that scientific terms have been derived by analogy from human phenomena.

He has now commenced a rigid logical chain. The next link is Interpretation—a special form of inference from the foregoing conclusion, showing how we learn the causes of things by applying human causation. He next exposes the fallacy of Materialism. It is another deduction from the same: he lays down as an axiom that man can have no perfect knowledge of anything but man, and the more objects resemble man, the better can they be known: much like the dictum of Protagoras that "man is the measure of all things." Therefore the universe cannot be deduced from purely material induction—which would be to explain the more known by the less known. And though he allows that it is impossible to conceive the mental causes of not-human individualities, yet it is still possible to formulate a sufficient theory of the universe.

The chapter on "Symbolism" is interesting ground; as it deals with principles that have such wide and familiar application, being the law of formation of "Aberglaube," whether springing up out of religious emotion or poetic frenzy, or as the delusions of insanity; besides prompting the numerous ceremonies of social life (*vide* Spencer's 'Ceremonial Government'). And thus we see that "material science is not the final wisdom, though absolutely necessary for two purposes—the perfection of our material civilisation, and the expression of our mental knowledge—the latter being accomplished by our arts and industries, which are more or less conventional." A long and various catalogue is given by way of illustration. "The perpetuation of symbols after they have ceased to be effective, is superstition." But symbols have the disadvantage of being proved of less homogeneous abstractions, and less true assimilations than the facts they represent. As a conclusion, he lays down that our mental knowledge cannot be expressed except by material symbols, but that as a "supreme mystery," the best of these consist of *the highest generalisations of physics, chemistry, and biology* Of course, he states expressly his theory of the universe, starting with the postulates of three ultimate principles (corresponding in function with Aristotle's Causes), viz., Substance, Motion, Order; by whose combination the whole mass of phenomena is produced. Substance appears in at least three grades—

Matter, Soul, Spirit—arranged concentrically, as it were, the last being inmost; but he says there may be an infinity of other modes within the last, as he cannot fix on an absolute centre: this possible numerical infinity gives the doctrine as a system less apparent firmness than, though it has much of the symmetry of, Hegel's, which claims a foundation on ultimate fact. Motion consists essentially in attraction. Order is best witnessed in the form of evolution; but it is hard to see why it should be distinguished altogether from motion.

As the crown of the universe comes the human system, which is treated of in the final and most characteristic chapter. It is, of course, shown to be only a special case of the preceding: it consists of a bodily organism to produce vital phenomena, a mental organism (soul) to produce the mental, and to observe the vital phenomena; and then a spiritual organism (spirit) to produce spiritual and observe the mental phenomena. Perhaps there is a partially formed organism within to observe the spirit, and possibly an infinity of germs arranged concentrically within this, like the infinite number of germs within an ovule, but which never as yet have attained actuality.

Then an analogy is traced between the vital and the mental organism, of especial interest to students of insanity being a paragraph (§ 14, p. 106) containing a description of the analogies of morbid states, on the principle that "the soul, like the body, is happy or miserable according to its state of health;" the modes of its application appear mainly correct. The ethical application is not neglected; for "the individual soul belongs to a great mental system." He deduces from his principles the strange ethical rule, "Classify yourselves rightly," as the best guide for practice. Some exception however must, we think, be taken to it, as long as it neglects an ideal of conduct. Perfection, according to his theory, is religion—the growth and life of the spirit; and has been variously spoken of as Nirvâna, the Great Awakening, being born again, absorption into the Deity, entrance into the Kingdom of Heaven, &c. Satan is a personification of Destruction —especially Spiritual Destruction.

After this sketch of the system, curiosity is awakened to

assign him a definite position among the constellations which the various philosophical schools form. And, as is the case with the authors of so many other systems, he seems to belong so much to all and yet so little to any of the rest, that it is somewhat difficult to fix his exact latitude and longitude. He seems also curiously disinclined to own allegiance to any of his great predecessors, however much the framework of his system may resemble theirs; though also he states more or less explicitly that he has read extensively—especially of the mystical writers, and indeed occasionally exhibits it by quotation—yet he seldom draws attention to the resemblance, either for more clearly expressing or for confirming his own views. Of all the chief systems, his reminds us most of Berkeley's; for just as the latter, taking vision as his theme, proceeds to construct an all-comprehensive theory, of which phenomena are the signs by which it is known to us, so does our author form a somewhat similar theory, starting from language as the proximate evidence of a subjacent reality: moreover, the goal of each is not widely remote; for though D. M. is no professed apologist for a Deity, he is scarcely a step from Pantheism.

And thus, though perhaps no single element of the work can be regarded as absolutely original, and the whole is rather a new turn of the philosophical kaleidoscope than a perfectly new piece of architecture, and is even rather bare in some important factors, such as the immensity and penetration of a Kant, and the richness and eloquence of an Emerson, yet the clearness of simplicity, the impartiality, and, above all, its connection with the circumstances of its genesis, make it one warmly to be recommended.

F. L. Benham, M.B.

Heidenhain on Animal Magnetism. ('Animal Magnetism, Physiological Observations,' by Rudolph Heidenhain. Translated from the 4th German edition, by J. C. Wooldridge. London: Kegan Paul & Co. 1880.)

"Animal Magnetism" seems to be entering on a new phase, that of strict scientific investigation. This is a matter of con-

gratulation, for the extraordinary character of the phenomena described under this term suggests questions, a solution of which must have an immense influence on physio-psychology. Though—as Mr. Romanes, who writes a preface to the translation, justly observes—Braid of Manchester, forty years ago published the results of investigations on this subject, which anticipated almost all that has been recently apparently rediscovered by Heidenhain, yet they did not succeed in exciting the attention they deserve from men of science, and "animal magnetism" has been left to quacks and mountebanks. Mr. Braid's works are likely now to be studied with a different interest, and we are glad to learn that they are about to be published again in a collected form.

Among other recent researches relating to hypnotism and allied states may be mentioned those of Czermak and Preyer, on the state into which some of the lower animals—especially fowls—can be thrown by fixing this attention in various ways; a condition for which Preyer has coined the name "cataplexy." The researches of Charcot at the Salpétrière on hysteria have also excited much interest and speculation.

It is the advantage of Heidenhain's work that the observations have been made on intelligent individuals in normal health, and, as far as that can be determined, reliable integrity; while the investigator himself has a name as a physiologist which at once vouches for the *bona fides* of the facts and methods employed for establishing them.

The memoir consists of two parts: the first, a semi-popular lecture, delivered at the beginning of this year; the second, a further series of observations, made in conjunction with Dr. Grützner, and of greater scientific precision.

It need scarcely be said that "animal magnetism," though it gives the title to the book, is used only as a term better known than "hypnotism," which was introduced by Mr. Braid, and adopted by Heidenhain throughout.

For the production of hypnotism there is no question of specific force on the part of the experimenter. Hypnotic experiments, however, do not succeed in every one's hands, or on all on whom they are tried. The susceptibility depends on the existence of, as the author terms it, a greater or less

degree of "sensory irritability," and, according to him, pale, anæmic individuals are most liable to hypnosis. Hansen, on the other hand—whose public exhibitions in Breslau originated Heidenhain's investigations—thinks active, muscular individuals are more susceptible; and therefore prefers the active Englishman to the phlegmatic German.

Whether the necessary "sensory irritability" exists primarily or not, the method first followed is to make the individual stare fixedly for some six or eight minutes at a shining faceted glass button, or other glittering object, the eyes being made to converge upwards as much as possible. This was introduced by Braid, but apparently the Egyptian conjurors produced the same effect by making the hypnotee stare at cabalistic signs on a white plate. In some persons the staring at a glass button for several minutes is all that is required to induce hypnotism, but usually manipulations or passes are required in addition.

The effect of staring fixedly for some time is, according to Heidenhain, to produce a condition of irritability which favours the establishment of the hypnotic state, just as excitement of the public mind generally increases the number of susceptibles. When the staring is kept up there is a feeling of dazzling lachrymation, dimness, and contraction of the field of vision, and the button seems to swim. Then follow spectra, and after images.

The manipulations or passes which are in most cases required in addition are merely weak, continued, and monotonous stimuli of the skin, or of the sense of hearing. The individual who makes the passes, or the "magnetiser," may even be dispensed with, provided the requisite monotonous stimulation is produced. Hence the mere ticking of a watch will hypnotise some. The cutaneous stimulation induced by the "passes," which consist in slowly moving the hands close to the hypnotee's face from forehead to chin, is a compound effect, partly tactile, by the draught of air set up, and partly sensations of temperature. A curious feeling is thus induced in the skin, though it is not actually touched. Some hands are more effective than others in thus stimulating the skin, and hence some people may fail because they have not the

warm moist hands which are found best, and they are not altogether uniform and steady in their movement. For the hypnotic condition is dispelled by strong, sudden, or irregular stimulation of those senses, stimulation of which in the reverse manner lulls consciousness to sleep. Thus cold, a touch, blowing on the face, a loud sound, a bright light falling on the eye, &c., are all sufficient to wake the hypnotee. A change in the direction of the passes, or a mere change in the retinal picture, by one operator taking the place of another, will also cause awakening.

In very susceptible individuals the hypnotic condition can be induced very easily, especially by acoustic stimuli, and even against the will of the individual. In some the idea of approaching sleep is enough to bring it on. Thus it is possible to make use of a specified hour, or some object previously agreed on at which the individual is to look, to induce hypnotism at any imaginable distance between the operator and medium. All that is required is the induction of the idea that sleep is coming on.

The first demonstrable symptom of the hypnotic condition is a spasm of the mechanism of accommodation, so that the "far" point approaches the "near" point. After some time also in most cases the pupils enlarge, the eyes open more widely, and the eyeballs protrude. There are almost infinite variations in the degree and manifestation of the phenomena of hypnotism, psychical and physical. The most numerous cases are those in which the incapability of opening the closed eyelids is the sole abnormal phenomenon. Next to these come a large number of people who cannot, or can only with great difficulty, open their mouth when it has been closed. There is spastic contracture of the orbicular muscles. In other persons the spastic condition is more or less general all over the body. Consciousness may, however, be completely retained in these cases, or only slightly reduced, demonstrable by some defects in the recollection of what has occurred.

In the types just mentioned the muscular phenomena form the chief, or at least the most prominent, features; in another series psychical phenomena prevail.

As regards the muscular system there appears to be an

increased reflex irritability, and tendency to tonic spasm. More or less marked cataleptic rigidity ensues, so that the limbs will remain fixed in whatever position they may be placed. Volition can be exerted only with great difficulty, and not unfrequently, instead of simple contractions, convulsive movements are set up which may become more or less generalised. By reflex irritation, such as gentle stroking of the skin, the underlying muscles can be thrown into tonic contraction, and with a greater increase of excitability irradiation occurs, following certain definite lines with remarkable uniformity.

Stroking the ball of the thumb causes adduction of the thumb. If this is increased, the muscles of the forearm, especially the flexors of the fingers, are thrown into contraction. The other movements of the arm are still, however, free. With further increase of the irritation, the whole of the muscles are thrown into tonic spasm, and the limb becomes stiff throughout. But in still higher degrees of irritability the spasm becomes still more extensive, and, as demonstrated by Heidenhain on his brother, the following was the march of the spasm: Left thumb; left hand; left forearm; left upper arm and shoulder; right shoulder and arm; right forearm; right hand; left leg; left thigh; right thigh; right leg; muscles of mastication; muscles of the neck.

Similarly, if the right foot is irritated, the spasm ascends the right leg, then descends the left leg; then ascends the right arm, descends the left arm; and ultimately invades the muscles of mastication and the cervical muscles.

A further investigation of the areas of reflex excitation led to the following curious localisation:

Stroking of the skin at the side of the spinous processes of the upper dorsal vertebræ caused elevation of the arms, with simultaneous slight flexion, so that the hands tend to meet above the head.

Stimulation of the lower dorsal region caused contraction of the latissimi and rhomboidei, with strong backward movement of both arms and simultaneous flexion.

Stimulation of last dorsal and first lumbar vertebral region caused spasm of the whole erector spinæ, with elevation of ribs (*lev. cost.; intercost.*), without contraction of diaphragm.

Stimulation over the lower lumbar vertebræ and sacral region, the person being seated, caused contraction of the flexors of the leg; then of the ileo-psoas, and hence (the thigh being fixed) bending of the body forward on thighs.

Stimulation of the sternal region caused contraction of the pectoralis major, with adduction of arm, and simultaneous action of the extensors.

If while the hypnotised individual is standing, the skin is stimulated at the side of the last lumbar vertebra, so as to produce a dragging downwards of the skin, the leg of that side moves backwards. Alternate stimulation of the same area on the two sides causes the individual to walk backwards with short steps.

If one side is stimulated successively, the leg moves backwards each time, till the legs are separated to their extreme limit as in spanning a broad ditch.

In muscular individuals the rigidity which can be induced throughout is so great that the whole body becomes as stiff as a board, and will remain supported merely by resting on the two ends.

In individuals who have been hypnotised the increased reflex irritability of the muscles lasts for some time, but it ultimately disappears if the experiments are not repeated for some time.

Next as to the psychical phenomena. In many persons, more or less profound sleep, mostly but not always accompanied by analgesia, alone occurs. Muscular phenomena may be totally absent during the condition of sleep, or there may be more or less developed catalepsy. In others, and those form the most interesting class, the cerebrum does not sleep as a whole, and the peculiarity occurs that during this state impressions made on the organs of sense are still able to excite correlated and co-ordinated muscular movements. Of these the numerous forms of "imitation automatism" are remarkable examples.

Movements carried out before a hypnotised individual, who apparently has his eyes shut, are nevertheless perceived by the eye, as the closure of the lids is not complete. "The perceived, but not consciously perceived, movement is imi-

tated. The same, with many movements, which are accompanied by a familiar and distinctly audible sound. I clench my fist before Mr. H——, who stands hypnotised before me; he clenches his. I open my mouth; he does the same. Now I close my fist behind his back, or over his bent head; he makes no movement. I shut my mouth, still over his bent head, rapidly, so that the teeth knock together; he repeats the manœuvre. I noiselessly contort my visage; he remains quiet" (p. 11). The optical or auditory impression liberates movements which have the type of voluntary movements, but are really not so. Sneezing and coughing are not imitated by hypnotised individuals; nor are laughing or singing. At most only facial contortions, or some of the associated movements, are carried out. The extraordinary imitative tendency of the hypnotised individual explains his apparent subjection to the will of the experimenter. In a loud voice the medium is ordered to do a certain action. Even though he may have no idea of the nature of the command, yet the performance of the action by the experimenter compels its imitation by the medium.

People who are at first somewhat intractable as regards imitation improve by continuous repetition of the movement before them, and the imitation often becomes marvellously exact even to the smallest detail. Passive movements communicated to a medium are as a rule continued by him, so that if he is made to walk he goes on readily. As a rule the medium does not remember, or at least cannot recall, what has occurred during his hypnotic condition; but that the impressions have been made is shown by the fact that with more or less suggestion what has been uttered may be brought up again in his mind.

A further very extraordinary series of phenomena, observed first by Berger, is described under the head of "speech automatism." Berger found that on applying pressure to the neck of a hypnotised individual, over the spinous processes of the lower cervical vertebræ, he could often be induced to repeat words spoken in his hearing; it being a matter of indifference whether the words were intelligible or not. The repetition is made in a very monotonous tone, which varies in individuals.

Some talk in a hollow sepulchral tone, others more softly, almost lisping; but the same person always repeats in the same way.

According to Berger, the hand must be warm; but Heidenhain finds the pressure of a cold hand just as effectual.

The following up of Berger's speech experiment led to the discovery that most persons who repeat when pressure is made on the neck, repeat also when one speaks, either simply, or better through a speaking trumpet, towards the neck without any pressure whatever, while they remain dumb when one talks towards any other part of the head, or even into the ear.

They repeat very readily and distinctly when the experimenter's speech is directed to the epigastrium, less distinctly when it is directed to the larynx, or through the open mouth to the back of the pharynx. If a vibrating tuning-fork is applied against one of these sensitive parts, a note like that of the tuning-fork is pronounced, while if the fork is held near the ear the medium often awakes with an expression of pain, and states that he has had a feeling of burning in the ear.

If by means of the tuning-fork the limits of the epigastric area are mapped out, it is found that it extends from about two finger-breadths below the sternum for about two inches downwards, and for about the same distance on each side of the middle line, while the lateral abdominal, umbilical, sternal and costal regions are all absolutely insensitive.

The sensitive epigastric area corresponds to the anterior wall of the stomach. And since the stomach, larynx, and pharynx all derive nervous supply from the vagus, the speculation is made that in some way the vagus conveys sound vibrations to the vocalising centre. It is further supposed that there may be anastomoses between the vagus and lower cervical nerves; but in a footnote (p. 64) it is stated that other sensory nerves besides the vagus may convey the sound vibrations, though the vagus seems more especially so adapted. These results are certainly of a very extraordinary character.

Under certain conditions hypnotised individuals also obey the command to carry out certain actions, and it is possible to

induce dreams by talking into their ears. In the dreaming state they readily reply to questions put to them, and carry out movements in accordance with their dreams. At first Heidenhain did not succeed in inducing these phenomena, but ultimately he was able to produce this "automatism at command" without difficulty. To obtain this it is necessary that the hypnotism should be less deep than for the imitation automatism, and this it was found could be brought about by laying the hand on the medium's head, a proceeding which has more or less tendency to cause awakening.

The character of the acts done at command is a guarantee of their genuineness, as they are such as would never be done by the individual in his senses. He acts in accordance with whatever suggestions are made, and exhibits the emotions proper to the conditions under which he is supposed to be placed—occasionally with unpleasant intensity. On awaking the individual either has no recollection of what has occurred, or can recall it more or less imperfectly with the aid of hints and suggestions.

The command automatism is a much more complex process than the imitation or speech automatism, for in these certain actions made by the experimenter induce similar actions in the medium. In command automatism, however, dissimilar actions are called forth—words calling forth actions. In those cases where the actions at command are not in immediate relation with some acted dream, commands are only effective in reference to very simple every-day actions rendered almost mechanical by repetition. The command must be *direct*. Thus such a sentence, "I should like to know the time" has no effect on the medium; but when he is told, "Show me your watch," he at once obeys. The command must also be *complete*. "To the door," causes no action; but "Go to the door," causes the medium to walk, not necessarily to the door, but away from his position, as if the command had been merely "Go." When requested to pass something, the medium lays his hand on anything that comes in his way, unless he is asked for something he is quite familiar with—say, in his own pocket.

Another series of phenomena, full of suggestive interest, is described under the head of "Unilateral Hypnosis."

In some persons stroking of one side of the head produces a paralytic condition of the opposite, or, it may be, of the same side of the body. The individual to be tested is made to sit down and the parietal region gently stroked or pressed with the warm hand. In those predisposed this induces first a weight in the arm, and then more and more complete paralysis. When he makes a violent effort to raise the limb spasms occur in it. In the case of Herr Heidenhain stroking of the left side of the head caused paralysis of the right arm and leg, and paralysis of the right side of the face—stated to be like paralysis of the facial nerve (?).

The medium at the same time is said to be aphasic, at least he cannot pronounce or repeat words. When the right side of the head is stroked in a similar manner all the phenomena appear on the left side, with the exception of the aphasia. If both sides are simultaneously stroked all four limbs become cataleptic, but no disturbance whatever occurs as regards speech or the facial movements.

If the left side be first stroked, producing right-sided paralysis and aphasia, and then the right side also, the aphasia disappears, and the limbs of both sides become affected. If, however, the left side is first stroked, and then the right, stroking of the left being omitted, the aphasia and right-sided paralysis disappear and left-sided catalepsy takes its place.

Measurement of the volume of the cataleptic arm by Mosso's volumeter shows that the blood volume is greatly reduced, as compared with that of the other. The phenomena are reversed when the cataleptic condition ceases.

In one case, Mr. W——, unilateral stroking caused catalepsy on the same side. The aphasia can only be induced in him by stroking the right side of the head. Berger, who has also worked at unilateral hypnosis, thinks that stroking the forehead causes crossed catalepsy; stroking the temporal region, catalepsy on the same side. The authors attribute the disturbance of speech to "contracture," or spasm of some of the muscles of articulation—especially the laryngeal—though the mouth can be opened and the tongue moved freely.

It is to be especially noted, in reference to unilateral hypnosis, that consciousness is not perceptibly affected.

But there are very remarkable disturbances of sensibility, more particularly investigated as regards vision, which are worthy of special attention. These have been carefully examined by Cohn, in conjunction with Heidenhain and Grützner.

It may be remarked also that Heidenhain has noted defective perception of temperature on the affected side, which, however, he has not further followed up.

As regards vision, the disturbances are spasm of accommodation and colour blindness, confined to the cataleptic side.

The accommodation spasm is so great that the "near point" is only twenty millimètres from the eye.

The condition of the eye as to colour perception corresponds to that given in Stilling's new Atlas (Table IV., b. l. 1, 2).

All colours appear different shades of grey—from dirty dark grey to a clear silver grey.

Though the eye is thus insensitive to colours, pressure on the eye or variation in pressure causes subjective colour sensations.

If the hypnotised eye has been kept covered for some time and then a coloured disc looked at, the disc appears coloured, not, however, with its own, but its complementary colour, e.g., a red disc appears green. But directly after this it appears grey, just as it does if the eye has not been kept closed.

Under the influence of atropin the phenomena change. Red and green still appear as different shades of grey. Blue and yellow, however, do not appear grey, but differently at different stages of the atropin action. First, yellow appears grey with a glimmer of blue. Second stage, yellow appears pure blue. Third stage, yellow appears blue with a slight tinge of yellow. Yellow is seen, as it were, struggling through a blue mist. Fourth stage, yellow appears mostly yellow, with a slight tinge of blue. When blue is tried the corresponding result is obtained, the blue with a slight yellow tinge is seen. During the action of atropin, yellow or blue passes from grey through the complementary colour to the true colour, while red and green appear only as different shades of grey.

It is suggested that as atropin removes the spasm of accommodation and also the colour blindness, there is a causal relation between the two phenomena. But on the other hand, as

physostigma produces spasm of accommodation, leaving the colour sense quite unimpaired, and as in many hypnotics accommodation spasm occurs without colour blindness, it is argued that atropin has a direct action on the elements concerned in colour perception.

The colour blindness produced by stroking one temporal region disappears by stroking the other side, just as in the aphasia similarly induced. Another curious fact ascertained by Cohn is that a person naturally colour blind, when unilaterally hypnotised, was able to distinguish colours which were otherwise undistinguishable.

It has been stated that in unilateral hypnosis the sensorium is apparently unaffected—indicating, it is argued, that one hemisphere of the brain fully suffices for all psychical functions. But more exact observation shows that there is a certain disturbance in the connection between sensations and movements on the hypnotised side.

In a person hypnotised on the left side, there is a certain diminution in the fluency of writing with the right hand, though the hand is otherwise quite movable. The handwriting acquires quite a foreign character. The letters are very close together, and not unfrequently a letter is reversed. It also appears that there is a very great tendency to imitative movements with the right hand during the unilateral hypnotic condition of the left, a tendency which in the normal condition does not exist. The involuntary imitation seems to be excited by the eye of the cataleptic side, for the imitation ceases when this is closed. From this the conclusion is drawn that the movements of each arm are influenced by both hemispheres.

Such are the main facts of this interesting and concise memoir, and they are such—admitting them all to be genuine, and this character they seem to have beyond all similar statements—as to justify the belief Heidenhain expresses, "that we have in this method a means of investigating the functions of the brain, the place of which can be supplied by no other method of investigation."

The hypotheses he offers to account for the phenomena, however ingenious and suggestive, have to us at present less value than the question of the bare facts themselves. Specula-

tion is easy, and we have had it *ad nauseam;* but speculation to be of any value must be strictly subordinate to a more thorough investigation of the pathological conditions. This inquiry comes specially within the province of physicians, who will see in many of the facts above mentioned suggestive resemblances with the phenomena of cerebral disease, functional and organic.

The hypothesis advanced by Heidenhain is that the phenomena of hypnotism are due to inhibition of the activity of the ganglion cells of the cerebral cortex; the inhibition being brought about by gentle prolonged stimulation of the sensory nerves of the face, or of the auditory or optic nerve.

That the lower centres, those of equilibration, &c., are active, seems the rule, though occasionally, during hypnotism, these give way also, and the individual falls down. The affection of the cortex explains why hypnotised individuals neither acquire conscious perceptions as the result of sensory impressions, nor spontaneously make voluntary movements.

"Normally when the idea of a movement presents itself to our consciousness, we can carry that movement into effect or not. In the hypnotic condition, owing to the absence of the inhibitory power of the will, the unconscious perception of the movement irresistibly brings it about—a process in all respects analogous to reflex action."

The inhibition of the cortex is not due to anæmia reflexly produced by contraction of the cerebral blood-vessels. An examination of the retina by Förster did not reveal any indication of this; and more convincing perhaps is the fact that hypnosis could be induced in one person during the action of nitrite of amyl, which enormously dilates the blood-vessels of the head. Arguments are adduced to show that the inhibition depends on irritation of certain sensory nerves, similar to the mechanism of reflex paralysis.

DAVID FERRIER.

Clinical Cases.

A CASE OF PROGRESSIVE MUSCULAR ATROPHY WITH UNILATERAL ATROPHY OF THE TONGUE.

BY BYROM BRAMWELL, M.D., F.R.C.P. EDIN.

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In the course of progressive muscular atrophy, and especially towards its later stages, it not unfrequently happens, as we all know, that the degenerative process which primarily had invaded the large nerve cells of the anterior cornua of the spinal cord, extends upwards and involves the motor nerve nuclei of the pons and medulla.

In such cases the characteristic symptoms of glosso-labial paralysis are added to those of the original affection.

In the following case of progressive muscular atrophy the degenerative process had extended to the medulla and pons, and had seriously affected the nerve nucleus of the 9th (hypoglossal), and to a less extent that of the 7th (facial), on the right side, the result being most marked atrophy of the right half of the tongue, and some wasting of the right cheek. There was no affection of speech, no difficulty in swallowing, in short, no symptoms of glosso-labial paralysis. All the movements of the tongue could be accurately performed; indeed, until I directed the patient's attention to the condition of the organ he was not aware that there was anything the matter with it. This fact, and the circumstance that the lesion in the medulla was so limited and so well defined, must be my excuse for reporting the case in what may perhaps be thought somewhat wearisome detail.

M. B., æt. 55, labourer, living in the Cowgate, Edinburgh, was sent to me by my friend Dr. Wilson, at the beginning of March of the present year, and was subsequently, at my request, admitted to the Royal Infirmary, Ward 23, where through the kindness of Professor Sanders I had repeated opportunities of examining him. I have also to thank Professor Sanders for allowing me to make use of his

notes, and Mr. Frank Rand, the clinical clerk, for valuable help in the examination of the case.

The patient's chief complaints were muscular weakness, most marked in the upper extremities, especially in the right; numbness and increased sensitiveness to cold in the right half of the body; and giddiness.

Previous History.—Ten years ago he began to feel his right hand and arm "numb and weak." The weakness slowly but gradually increased. After a time (the exact date he was unable to fix) the left arm and hand became similarly affected. Until two years ago he was able to follow his ordinary occupation, that of a labourer. The weakness then (two years ago) became so great that he had to take to chopping sticks. For the past year he has not been able to follow any employment. Ever since the muscle weakness was first noticed he has been subject to attacks of "lightness in the head." These attacks have been much worse of late, and he has in consequence had several falls.

He knows no cause for his complaint. His general health until lately has been particularly good. He has been fairly temperate. Has not had syphilis. Like most labourers, he has been a good deal exposed to wet and cold, but has never suffered from rheumatism. His surroundings until lately have been fairly comfortable.

Family History.—Good. His father and mother died at an advanced age. His brothers and sisters (five in number), and his own children, are all healthy. So far as he knows, he has no hereditary tendency to nerve complaints.

Present Condition.—He is a small man, and looks much older than his years. Is very feeble, and walks with difficulty by the help of a stick, the gait being tottering and senile. He has a marked stoop.

There is a recent scar over the right eyebrow, the result, he says, of a fall during an attack of giddiness.

Nervous System; Motor Functions.—The muscular power generally is very much below par. The weakness is extreme in the upper extremities, especially in the right. The patient is unable to "spread" the fingers of the right hand. The movements of the phalangeal joints of the fingers and thumb of the right hand are imperfect. This is in great part owing to joint stiffness. All the other movements of the right upper extremity can be performed, though with extreme feebleness, the slightest passive resistance being sufficient to prevent their execution. The grasping power of both hands, as measured by the dynamometer, is much below par, that of the right being much weaker than that of the left.

The right hand presents to some extent the "bird-claw"

character, but the appearance is not typical, owing to the fact that the fingers and thumb are rigid at their first phalangeal joints.

The rigidity of the little finger dates from childhood, and is the result of a fracture; that of the ring-finger was caused by an abscess some few years ago; that of the middle finger resulted from an injury thirteen years ago; that of the thumb dates back twenty years, and resulted from an injury; that of the forefinger came on of itself, without any obvious cause. (? Could these injuries have been in any way the cause of the disease? Could they have been the exciting cause of an ascending degeneration, which primarily affected the nerve nuclei supplying the hand muscles?)

The fingers of the left hand are slightly flexed at their first phalangeal joints. There is some stiffness and rigidity on passive movement at the same joints.

All the small muscles of the right hand and thumb are in an extreme state of emaciation. The muscles of the right forearm and the muscles attaching the right upper extremity to the trunk are also much wasted. The atrophy is more marked in some muscles and in some parts of muscles than in others; the upper part of the trapezius, for example, is much more affected than the lower.

The small muscles of the left hand and thumb, and of the left upper extremity, are also atrophied, though in a less degree than those of the right.

The right half of the tongue is much wasted; it is soft and flabby, marked with furrows and wrinkles, and presents a striking contrast to its plump fellow of the opposite side. The atrophy is accurately limited to the middle line. The tip of the organ when fully protruded is slightly turned to the right (atrophied) side. All the movements of the tongue can be accurately performed; in fact, as I have already remarked, until the patient's attention was directed to the condition of the organ he was not aware that there was anything the matter with it. The soft palate and uvula are natural. There is no difficulty in speech, mastication, or deglutition.

The right side of the face is somewhat atrophied, the wasting being most marked in the cheek, which feels thinner and less firm than the left.

The other muscles supplied by nerves coming off from the medulla and pons seem normal. The muscles of the trunk, with the exception of those before mentioned, and the muscles of the lower extremities, are soft and flabby, but do not present any appearance of special atrophy.

The *mechanical irritability* of the atrophied muscles seems natural. *Electrical irritability*, a careful examination of the

atrophied muscles, including the tongue, show a simple diminution, especially in the strength of the contraction produced, to both forms of current. There is no trace of "reaction of degeneration;" even in the muscles which seem most atrophied a contraction can be obtained by a strong faradic current. Very marked fibrillary twitchings frequently occur in the atrophied muscles, including the right half of the tongue.

The *reflexes* (superficial, deep, and organic) all normal.

Co-ordination seems normal.

The *muscular sense*, as tested by weights, appears to be normal.

Sensory Functions.—He complains of feeling cold. Says that the left side of his head and the right side of his body are numb.

Tactile sensibility and the *power of localising* impressions are natural.

Sensibility to pain is natural.

Sensibility to temperature is imperfect. He can always distinguish cold objects, indeed sensibility to cold is increased, but he not unfrequently says warm objects are cold. At other times a pretty prolonged contact of a warm object is necessary before it is recognised as such (delayed impression).

Sight.—The left eye is blind, the result of an old injury. Sight in the right eye is fairly good. Nothing of importance was detected on ophthalmoscopic examination.

Taste is natural.

Smell is natural.

Hearing.—Aërial sounds are very imperfectly heard in the left ear; the skull sounds, as tested by the tuning-fork, are well heard on both sides.

Intelligence is good. The patient sleeps well, and with the exception of occasional attacks of giddiness feels nothing wrong with his head. The attacks of giddiness are of short duration, and generally occur when he gets up or turns round quickly. He does not vomit, and has never had a fit.

The *temperature* is normal or *subnormal.*

The *radials* are somewhat hard and rigid; the heart is weak; and there is slight bronchitis. But with these exceptions the other organs and systems are normal.

The patient remained for some time under observation in hospital. His general health improved considerably. The muscular condition underwent no obvious change. He used to like faradisation, thinking it did him good. When last seen (Oct. 7th) he was much *in statu quo.*

COMPOUND FRACTURE OF SKULL—COMPRESSION OF BRAIN BY CLOT BETWEEN THE SKULL AND DURA MATER—RECOVERY.

UNDER THE CARE OF T. PRIDGIN TEALE, M.A. OXON., F.R.C.S.

T. S., aged 28, a groom, was kicked on the head by a recently shod tram-horse, on the morning of October 17th, 1879, and was at once admitted into the Leeds Infirmary.

Condition on admission, at 10.30 A.M. There was a wound about two inches in length, situated three inches behind the right frontal eminence, and just in front of a line drawn from ear to ear. The skull was fractured, and a large piece of bone was depressed, and there was free hæmorrhage from within the skull. Pulse 55. Respiration 12. Patient comatose.

Having enlarged the wound, Mr. Brown, the house surgeon, removed the depressed portion of bone. Immediately after the bone had been raised, the patient opened his eyes and felt greatly relieved.

At 11.30 the pulse was 88, and there was free bleeding from the wound.

Oct. 18th. Day after the accident. There is a loss of motor power in the left arm, gradually increasing, but without loss of sensation. Left leg natural. Patient conscious.

Oct. 20th. Patient's symptoms worse. Inability to answer questions. Left hemiplegia complete. Temperature at 4 P.M. 104°·3. Pulse 60. Incontinence of urine. A large clot in the wound. He was seen by Mr. Pridgin Teale at 11 P.M. He was then unconscious. Mr. Teale, believing that his symptoms were due to compression of the brain by a large, firm clot occupying the site of the removed bone and extending beneath the skull for some way, but external to the dura mater, broke up with the finger the clot, but did not remove it as it was firmly adherent to surrounding structures. In six hours the patient's temperature became normal, and he was more conscious.

Oct. 21st More indications of returning consciousness.

Oct. 22*nd.* Answers questions. Has regained power over the bladder. Is still hemiplegic.

Oct. 25*th.* Hemiplegia disappearing.

Nov. 10*th.* Hemiplegia quite gone.

Henceforth he made good progress, and was discharged apparently sound, Feb. 8th, 1879, and is now, Sept. 1880, well and following his employment as a groom.

This case is interesting. First, as showing the direct results of compression by depressed bone, immediately relieved by removal of the compressing causes. Secondly, in the gradual development in detail of symptoms of unilateral pressure by blood external to the dura mater, and not in an absolutely confined space, the pressure being due to the "setting" of the clot into a stiff mass. Thirdly, in the immediate commencement of retrocession of the symptoms, as soon as the cohesion of the clot had been broken up. (Mr. Teale did not think it well to scrape away with instruments the firmly adherent clot, lest the hæmorrhage should be reproduced.)

The order in which the symptoms improved is well shown. 1st. The fall in temperature. 2nd. Return of consciousness so as to understand what was said to him. 3rd. Ability to answer questions, and recovery of power of micturition. 4th. Slow recovery of power of leg and foot. The first symptom of the onset of the second period of compression was loss of motor power in the left arm.

ON FUNCTIONAL ATHETOSIS AND INCOORDINATION OF MOVEMENT.

BY LEWIS SHAPTER, M.D. CANTAB.

Physician to the Devon and Exeter Hospital.

J. P., aged 7 years, thin and delicate, but intelligent in appearance, was admitted into the Devon and Exeter Hospital on the 20th of February, 1879. There appeared to be a general tendency to tonic spasm of the flexor muscles of the left side of the body, as evinced by distortion of the hand and foot, on movement and at rest; an inability to keep the left side of the body in any one position for any length of time; and a strained incoordinate movement of the arm and leg when seeking to attain any special object. When at rest the left arm appeared to be retained awkwardly or with difficulty at the left side, with the fingers of the hand extended, or the palmar surface of the fingers pressed firmly against the hip. On moving the arm for any definite purpose the fingers at once became abducted from the middle line, from probable spasm of the dorsal interossei, and the palm of the hand would be drawn inwards, so as to form an arch with the lower part of the forearm from spasm of the flexors. On being told to touch his nose, e. g. with the forefinger, the fingers at once become abducted from the median line, and tend to close inward on the palm; the wrist becomes rounded; the palm with the lower part of the forearm becomes arched; and the hand, spasmodically moving, is first placed on the chest, with the view of pressing the fingers firmly against the body to prevent their closing: the whole hand is then at length sprawled over the face in a vain endeavour to accomplish the task imposed. With the eyes shut, all these movements become more strained, complex, and difficult. On examining the left foot it is clear that it is similarly affected to the hand, and the normal antagonising force between the flexors and extensors is lost. On standing erect he rests the weight of his body on his right foot, and bending over slightly to that side advances his left leg straight outwards from the hip, the knee being unbent, the os calcis drawn up, and the toes

extended with their tips presented to the floor. The condition simulates talipes equinus, with dislocation of the hip into the thyroid cavity. By a strong effort of the will he can restore the balance in muscular action, and the sole of the foot is thus brought flat upon the ground, but this is only for a time, until the opposing muscles are wearied by their overwork.

Beyond this spastic condition of the flexor muscles there appears to be no disorder indicative of nerve lesion; sensibility to touch, pain, heat, and cold appear normal; there is neither numbness nor pain; galvanism of the flexors and extensors affords no reliable results; but the arm and leg are perhaps somewhat wasted in certain parts, such, e. g., as the calf of the left leg. The abnormal muscular action, it is most important to observe, was continuous rather than jerking, and rapidly recovering or spasmodic. The movements resulting from the tonic muscular spasm, might, indeed, be described as slow in attaining their object, deliberate, and forcible.

The history of the case, according to the account of the mother, was as follows:—When three months old the child was vaccinated on the *left* arm, after which an abscess formed on the outer side of the same arm, which broke and subsequently healed. About this time it was noticed that his hand was constantly moving in a peculiar manner, and when he began to walk he walked on the tips of the toes of the left foot. These symptoms have since increased. The child was always weakly, and the three brothers and three sisters are also delicate; but, as far as can be ascertained, there is no defined disease in any of them.

The treatment consisted in the use of the bromide, of conium, and of the extractum physostigmatis; both of which latter drugs were pushed to the production of physiological effects. On one occasion he was placed under chloroform, with the view of observing how much of the acquired distortion depended upon muscular spasm, and with the further view of getting the foot into such a position as to render a boot adaptable. As results, spasm was temporarily relaxed, deformity removed, and a boot adapted; but this latter, after some days, was obliged to be again removed. Special treatment directed to the existence of spasm was, on the whole, unsuccessful; but under tonics and attention to general nutrition some benefit was derived.

Under the name of Athetosis (Αθετος, without fixed position) Dr. Hammond first described an affection which is mainly characterised by an inability to retain the fingers and toes in any position in which they may be placed, and by their continual motion. Dr. Hammond illustrated the disease by two cases, one an intemperate epileptic who after an attack

of delirium tremens, followed by unconsciousness for six weeks, complained of numbness in the whole of the right upper extremity and in the toes of the same side, severe pain in these parts, and complex movements, which were to some extent under the control of the will, especially when this was strongly excited and assisted by the eyesight: coincidently with the development of this condition the memory became impaired, and the intellect manifestly weakened. The second case was also an epileptic, who, after an attack of aphasia, developed numbness on the affected side, incoordination and loss of voluntary muscular motion of the right forearm and leg, loss of antagonising force between the flexors and extensors both of the fingers and toes, and slow moving pains from the hand and foot up to the body. Both cases, therefore, came on with epileptic paroxysms; both were characterised by complex movements of the fingers and toes, with a tendency to distortion; both were also associated with similar head symptoms, tremulousness of the tongue, numbness on the affected side, and pains in the spasmodically affected muscles; but in neither case was there any paralysis. Hammond's view as to the pathology of the disease was purely hypothetical; but he associated the disorder with the intra-cranial ganglia and the upper part of the spinal cord, and named the corpus striatum as one probable seat of the morbid process. Since Dr. Hammond described such a special form of unilateral motor disturbance, under the name of Athetosis, in 1871, other illustrative cases have, from time to time, been recorded by Dr. Gowers, Professor Gairdner, Charcot, Dr. Munro, Dr. Claye Shaw, Dr. Sydney Ringer, and Dr. Clifford Allbutt. Some few of these recorded cases have involved general bilateral irregularity of movement, whilst others have been post-hemiplegic and unilateral; but all appear to have been connected with, or preceded by, other disease of the nervous system, and thereby afford evidence that the pathological change (whatever it might be) causing the disordered movement has been secondary to, or dependent on, a permanent lesion of the higher encephalic centres.

In some few cases pathological research has come to our aid. Charcot found in three cases of post-hemiplegic irregular choreoid spasm occurring on movement, lesions involving the posterior extremity of the optic thalamus, the posterior part of the caudate nucleus, and the most posterior part of the corona radiata; and in these posterior fibres of the corona radiata he assumes there is a special motor function, alteration in which causes choreoid spasm. Dr. Gowers ('Medico-Chir. Transactions,' vol. lix.) reports a case of post-hemiplegic incoordination affecting the arm

only without spontaneous mobile spasm: the brain revealed but one lesion, a cicatricial induration of the optic thalamus extending across its centre beneath the upper surface, but not involving the ascending white fibres from the crus. Dr. Sydney Ringer ('Practitioner,' September 1879) in a case of post-hemiplegic athetosis, found the disease on examination to be limited to the optic thalamus, corpus striatum, and the parts just external. The corpus striatum was the part which suffered most, but the left optic thalamus was also wasted. Dr. Ringer remarks that it is obvious that the cavity in the brain could not be the immediate cause of the incoordinate and involuntary movement of athetosis, for this breach of continuity could only cause paralysis. "The athetosis, therefore, must be attributed to the damaged tissues in the neighbourhood of this cavity, and must, in this case, be due to the damage in the optic thalamus or the corpus striatum or both." It is beyond my present purpose to discuss how far the special phenomena of athetosis are to be dissociated from the commoner characteristics of fixed and mobile spasm so often occurring in partly paralysed limbs, and consequently I may be debarred from considering how far atrophy and degeneration of the basal ganglia may be looked to as the sources which give rise to the phenomena peculiar to post-hemiplegic athetosis. Considering the observations of Crichton-Browne and Meynert on the optic thalamus as a reflex centre, we can with Dr. Gowers readily understand how lesion of this organ alone may account for the disease. My desire rather is to look apart from the basal ganglia for a point from which to ground an explanation of the causation of the phenomena peculiar to athetosis as a functional disorder.

According to the observations of Tcheschechin, the centres of innervation of the movements of locomotion are found at the protuberance, and as high up as the cerebral peduncles, and these centres are in communication with the different encephalic centres that are attached to the protuberance by the middle cerebellar peduncles and cerebral peduncles. Lesions of these centres, or peduncles, occasion a disturbance in the co-ordination of movements, and also unilateral lesions to the peculiar movements of rotation, such as whirling, motion on a pivot, rolling, or somersaults. Although, therefore, we cannot physiologically regard the protuberance as the seat of transition between the spinal cord and the higher perceptive or volitional cerebral centres, we can at least accord to a "centre" which is one of the principal seats of the reception of sensations, a function presiding over the movements of locomotion, and liable therefore as a "centre," especially in the young with growing nerve elements, to receive partial or

permanent damage or alteration of function from injury or even shock, direct or indirect, or reflex.

The case of athetosis under consideration is one unassociated with other nerve lesion either past or present, and presumably it is dependent on atrophic changes in nerve elements of spinal centres, and primarily due to shock indirect or reflex.

The clinical features characteristic of the disease are briefly (1) tonic, slow, more or less designed, and perfected muscular spasm, especially of the flexors; (2) motor incoordination; (3) distortion, the result of unopposed muscular contraction; (4) a want of controlling volitional power, whether such want is really dependent upon a loss of power, or only upon a local ataxia of the agent to be controlled.

Now the point naturally at issue to every clinical investigator is the cause of the incoordinate movement; or, in other words, is this incoordination a result of an affection of the co-ordinating spinal centre, or is it merely a mechanical result of flexor spasm which would necessarily give rise to an awkwardness and irregularity of movement?

In locomotor ataxy we have incoordination of movement as a pathognomonic feature, and although this incoordination is, in the majority of cases, intimately connected with spinal lesion, preventing conductivity of motor force, it is not necessarily dependent upon it. As Trousseau observes, it would be wrong to regard the disease as dependent on such conditions as the palpable lesions found, since they are only a consequence and an effect. Incoordination of movement, indeed, when it exists as a purely functional disorder in a class of cases free from any other implication of nervous function, speaks against the *necessary* dependency of co-ordination on the evolution of force from nerve centres. An example of this class of case I ventured to publish, in 1872 ('Med. Times and Gazette'), and I then drew attention to the fact that incoordination, as occurring without the supposed necessary lesion involved in posterior spinal sclerosis, could not be regarded as necessarily dependent upon it; but that we had rather to view, with Dr. Lockhart Clarke, a disorder of that physiological state (viz. tonicity) of the muscles, which, as dependent on reflex action, maintains the constant state of partial contraction, and keeps the antagonistic muscles in equilibrium or static tension. Incoordination of movement may then, clinically and physiologically, be a local disorder in the antagonising muscles themselves, and is the result of a loss of the physiological state of tonicity. In posterior spinal sclerosis, again, there is found a sufficient lesion, not only to interrupt the ordinary cycle of events and to disturb the necessary reflex act upon which co-ordination is dependent;

but also to produce an irritation to react upon the cord as a centre, and so occasion an evolution of motor force upon which harmony of action must be directly due. Incoordination then being, from the nature of the case, a disorder of motor force, and the cord being a generator as well as a transmitter of nervous force, we find in posterior spinal sclerosis motor action, irregularly distributed through the proper nerve channels from a nerve centre, and connected with a morbid condition of the sensory system, or that part which goes to complete the cycle necessary for the production of a reflex act. In athetosis we have only to go a step further, for we have to deal with unilateral incoordination of movement, presumably the result of disorder of a special incoordinating centre, encephalic in location. It follows also that in all cases of post-hemiplegic athetosis there must necessarily be a continuity of function between the motor path and the grey matter of the centres, and it must be assumed that the lesion causing the associative hemiplegia is only partial as regards the grey matter, and consequently permits of that "central irradiation of voluntary impulse" insisted upon by Nothnagel.

Finally, we are asked by many investigators to see a connection between athetosis and chorea, paralysis agitans, writer's cramp, spastic paraplegia, &c. Hemichorea is thought to bear the closest analogy, but if the pathognomonic feature of athetosis is incoordination of movement, and the pathological element disorder of the co-ordinating centre at the protuberance, the disease is sufficiently well-defined to render comparisons of minor clinical details dangerous and inconvenient. Chorea has its own clinical landmarks. In the so-called "insanity of the muscles," in the morbid restlessness, degree of variety, and combination of the involuntary movements; in the rapidly recurring and alternating flexion and extension, pronation and supination, abduction and adduction, occurring in the upper and lower extremities; and finally, in the "dreams of movement" which may occur during sleep, we have surely clinical characteristics that need not be confused or even dwelt upon. In athetosis we find little or nothing in common with chorea; the incoordination of movement, the flexor spasm leading to distortion, and the slow tonic designed character of the spasm, are phenomena distinctive and pathognomonic. It has been with the hope of rendering these signs more generally accepted, that I have thought a case of "functional" athetosis, uncomplicated with any other nerve disorder, worthy of consideration.

CASE OF CONGENITAL ABSENCE OF THE CORPUS CALLOSUM.

BY A. R. URQUHART, M.D.

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THE following is a *résumé* of the bodily and mental characteristics during life, and the post-mortem appearances of a case that occurred under the care of Dr. Parsey, Warwick County Asylum :—

E. E. was for seven years an inmate of the Idiot department of that Asylum. She died of empyema. During life she gave no occasion for any note of interest in the case-books—being regarded as an imbecile with certain vicious propensities rendering it necessary to place her under proper care and control. The rare cerebral defect was only discovered on the post-mortem examination; and thereupon these notes were compiled from the recollections of medical officers and staff. I believe they may be accepted as accurate, though to so great an extent negative in character.

I. *Bodily Characteristics.*—The general appearance of E. E. when in repose called for no remark. She was of middle height, well nourished, and well developed. Expression somewhat fatuous, but not devoid of intelligence.

The shape of head was irregular and globular, taken in the manner recommended by Mr. Crochley Clapham.

The vital functions were duly performed, and she was healthy and vigorous till the fatal illness.

The most marked abnormality was a certain want of muscular co-ordination. This, however, did not obtain to such an extent as to make her the object of general remark among her fellow-patients. She fed herself in the dining-hall with knife and fork in a slightly awkward manner. She could pick up a pin. She was taught sewing, and got as far as hemming dusters, but the result was very indifferent. Indeed, the nurse described it as the "worst sewing she had ever seen." When thus employed she would prick her fingers, and turn out

"childish" work—very irregular in size of stitch and line. Her hands were small, the fingers round and stumpy.

The want of co-ordinating power was most marked in her gait. She took regular exercise round the grounds, and always walked with a gliding motion, never lifting her feet. In the airing-court she was generally to be found moving close by the wall—evidently from preference. She would fall on the slightest push, even if standing still and expecting an attack, so precarious was her balance.

All her motions had a tendency to become automatic. When engaged in scrubbing the floor she wet her garments, and would continue to work at the same spot till moved by the nurse. She used a duster in the same mechanical way. These automatic movements were very noticeable when she scratched her head.

There is unfortunately no accurate record of the state of her special senses. They had been so far normal as to have attracted no notice.

The tone of voice was gruff and peculiar. The nurse in charge stated that she never heard one like it. The only sound she could liken it to was the bark of a dog—not shrill, but thick and sudden.

For a long time after admission she never spoke, till one day the nurse heard a strange and curious voice in the court, and found that it was E. E. scolding. Indeed, her powers of language were seldom exerted save under the influence of rage, when she would swear freely, using many different oaths. She seemed to collect her faculties during a short preliminary pause, and then ran the words of her brief sentences into one another, bringing them out "all of a sudden." This rendered it difficult to make out what she said.

II. *Mental Manifestations.*—E. E. was not possessed of a high degree of intelligence.

She was timid, and stood in awe of her stronger neighbours. If observed working mischief by the nurse, she would desist at once—at times refusing to speak when questioned on the point, and at times in angry tones denying her fault, and blaming another patient by name.

She was occasionally destructive and mischievous, gave much trouble by constant destruction of boots, etc., and by scratching the painted walls and doors.

She constantly pinched and thumped other patients in a very sly way, and was both spiteful and revengeful. Towards the close of her life these traits became more marked, and for that reason she spoke more. Two patients and the night nurse she seemed to regard as special enemies. One of these patients was weakly and inoffensive, the other aggressive and

powerful. It was only when there was but little risk of discovery that she meddled with the latter. So troublesome was she in this respect, that when the nurse found the "ward up in arms, harmless patients and all," she generally found that E. E. was the cause of the tumult.

She gave the night nurse all the trouble she could by wetting her bed; and, if possible, by changing her own fouled linen for the dry clothing of a near neighbour in the dormitory. She was evidently uncomfortable when wet, and never so misbehaved in the daytime. Her general arrangement for the night was to place the macintosh sheet below the mattress.

So troublesome was she in the dining-hall that a nurse kept close beside her to prevent these tricks. The most common was her inveterate habit of stealing—not from hunger, but apparently for the mere love of mischief. She would sip a little out of her own cup and exchange it for the full one of a helpless neighbour; or as she passed along would rapidly throw the slices of bread underneath the table, with no intention of eating it.

She did not give signs of pleasure readily, being singularly apathetic; but she showed considerable fondness for children and others. At night she carried certain helpless little ones upstairs to the dormitory, and had an evident preference for them. She, however, performed this duty in a very clumsy fashion, as might be expected, getting upstairs crabwise and slowly.

The nurse in charge of her ward was a special favourite. She would promise this nurse to keep her bed clean; but soon forgot her promise in telling the night attendant that she meant to "serve her out" by misbehaving.

She exhibited no sign of jealousy.

The faculty of attention was not strongly marked. While in the Asylum school she would intently stare at her teacher for a time, but nearly always had to be turned out on account of her mischievous propensities, e.g., for kicking the others underneath the table. She never showed any sign of having learnt anything, though she had been tried with object lessons, shapes, numbers, colours, and reading.

She had little or no idea of time, and required to be called to meals. She would (but rarely) tell the head attendant of the department that "the doctor was coming." There was a certain amount of reasoning and reflective power. Ideation, however, was very slow; she always paused before speaking, and during her illness she took little, if any, interest in her treatment, and was awkward and tardy in obeying instructions.

Her habits were untidy and filthy.

She was most acquisitive. Did she want anything (say a comb or brush), she would not return it to its place; but quickly and secretly hide it away. But she seemed to make no use of accumulated finery or rubbish. For years she carried about twopence-halfpenny in coppers in her hand, till they became green and worn. One day, when visited by a friend, she changed them for clean coins, but never evinced any desire or idea of spending them.

In conclusion, we find that the chief bodily want was a deficiency in co-ordinating power over the muscles; while the mental faculties were, generally speaking, developed to a slight extent. The higher faculties were either entirely absent or present in a slight degree. Attention, imitation, ideation, the moral sense, were extremely limited in scope; and education seemed to fail in developing them.

III. *Post-mortem Examination: Head.*—Calvarium very thin, extremely irregular in shape, shortened antero-posteriorly, and nearly circular. The greatest diameter was from the right frontal to the left occipital region. The measurements of the interior of the skull were: length, 6 inches; breadth, 5 inches; depth from vertex to posterior clinoid processes, 3¼ inches; circumference, 17½ inches. The right side of the skull was flattened posteriorly, and bulged slightly anteriorly, so that the hemisphere of that was, as it were, somewhat pushed forward.

Dura mater non-adherent. Frontal lobes much shortened, orbital depression very marked. Convolutions small and simple, especially in frontal and occipital lobes. Corpus callosum represented by a rudimentary ridge on either hemisphere. Gyrus fornicatus convolution absent, numerous radiating convolutions taking its place.

On removing the brain, which was soft and flabby, the hemispheres at once fell apart, disclosing the absence of the corpus callosum, together with the fornix and septum lucidum. A thin pellucid extension of pia mater served to connect the hemispheres.

The small size of the cerebral hemispheres, the simple character of the convolutions, and the absence of the corpus callosum, were the most remarkable features. In other respects the brain was apparently normal.

Remarks.—Cases of this abnormality have been recorded by Paget, Sully, Reil, Langdon Downe and Christie.

In all (as far as I have been able to ascertain) the mental faculties were defective. But in cases where the abnormality was incomplete, where there was only a partial arrest of

development of the corpus callosum, fornix and septum lucidum, the intellectual functions were not so much impaired.

The case described by Sir James Paget was an example of this pathological condition, and had been a domestic servant, whose mental aberration was confined to a want of forethought and an abrupt flighty manner. She had a slender education, a good memory, was trusty and competent in her sphere of labour, and bore a good moral character.

The other cases showed very low degree of mental development, with very limited command of language. The case above recorded presents a comparatively high standard, notwithstanding the extensive absence of the commissural system.

We may conclude that these structures are necessary for a high degree of mental evolution, that their partial absence is attended by slight intellectual defects, while their total loss causes varying degrees of idiocy and imbecility. It is impossible to affirm that speech is affected by this want more than any other intellectual faculty.

Abstracts of British and Foreign Journals.

The Central Sulci in the Carnivora.—Professor Pausch, of Kiel, in the course of a monograph upon the Morphology of the Mammalian Brain, describes the sulci in the cerebrum of the Carnivora (Beiträge zur Morphologie des Grosshirns der Säugethiere. I. Die Furchen am Grosshirn der Carnivoren. *Morphologisches Jahrbüch*, Bd. v. ss. 193–239, Taf. xiv. u. xv.). The first portion of his paper is devoted to the Canine, Feline, and Ursine families, and is illustrated by two double plates of fifty-five figures.

I. The Dog group. Canina.—The brains of the fox and of the dog, the latter in various stages of development, are described and figured. The author concludes that the brains of the fox, wolf, and dog have the same type in their sulci; and that, further, when this type shows itself in the simplest form in any species it is also subject to the most trifling individual variations, and *vice versâ*. Thus, all fox brains display almost precisely the same sulci, while in the dog great variations may be seen, the two halves even of the same brain displaying maybe seemingly fundamental differences. It is true that the probable clue to this should be sought for in the numerous varieties or races into which the dog, as the oldest and most widely distributed domestic animal, has become separated.

II. The Cat group. Felina.—The brain of the cat in its various stages, and that of the lion, tiger, leopard, panther, and hyæna. Taking the brain as a basis of comparison, the feline tribe is well marked out as a natural group according to Professor Pausch; for there, while the sulci show on one side or surface agreement with those of the canine brain, on the other side they display characteristic variations therefrom.

III. The Bear group. Ursina.—The brain of the marten and weasel, the otter, the coati and raccoon, the bear, and the mungoose and genette, are described and figured. In the ursine group it is concluded that there is no such agreement in the typical features

of the brain as exists in the two preceding divisions, and that accordingly three sub-groups may be formed, viz.:—

a. That including the musteline and ursine families. Through the coati a transition may be made to the next sub-group.

b. That comprising the lutrine family, including the otter and raccoon.

c. The sub-group formed by the viverrine family, to which may be added the genette and mungoose.

From a study of the brains of the animals above mentioned, Professor Pausch has constructed a diagram of the sulci and gyri of the typical Carnivora brain.

The Brain of the Hippopotamus.—In a recent number of the Transactions of the Zoological Society (vol. xi., 1880, p. 11) there is a description, accompanied by five figures, by the late Professor Garrod, of the brain of an adult specimen, about thirteen years old, from the Upper Nile, of *Hippopotamus amphibius*. Professor Gratiolet had previously described the brain of the same species in a well-known monograph on its anatomy ('Recherches sur l'Anatomie de l'Hippopotame,' Paris, 1867); and Professor Macalister has given an outline sketch of the same organ in *H. Liberiensis*, *Proc. Roy. Irish Acad.* vol. i. ser. 2, pl. xxviii.

The weight of the brain immediately after removal was 1 lb. 7 oz. Professor Garrod adopts the nomenclature used by Dr. Krueg in a recent monograph on the Brain in the Ungulata (*Zeitsch. für wissensch. Zool.*, 1878, ss. 297–344).[1] The brain is not richly convoluted, being about as much so as that of the genus *Bos*, and decidedly less so than that of *Camelopardalis giraffa* or the Camelidæ. The brain of *Ceratorhinus Sumatrensis*, a much smaller Rhinoceros (see *Trans. Zool. Soc.* vol. x. pl. lxx. p. 411), is much richer in convolutions. The arrangement of the convolutions on the two sides of the brain which is the subject of this note differs so much that, from a study of one or the other singly, very different results might be arrived at. This is evidently due to the considerable development on the right side of bridging convolutions, the great number of which in the brain of the hippopotamus is particularly remarked by Gratiolet, who, in reference to the "middle series" of convolutions, remarks: "Il acquiert une importance exceptionnelle, et si son existence est au premier abord dissimulée, cela tient à la grande quantité de plis de passages verticaux qui lient cet étage supérieur à l'étage inférieur proprement dit." On the left side these bridging con-

[1] Abstract in 'Brain,' Part IV., p. 379.

volutions do not exist. The Sylvian fissure is insignificant in size, the fissura rhinalis being continuous with it before and behind. As already remarked by Gratiolet, the optic and olfactory lobes are small, and the corpora quadrigemina not greatly developed. "Looked at generally," concludes Professor Garrod, "the brain of the hippopotamus is evidently very different from that of the genus *Sus* and its nearest allies. In the great breadth of and complicatedness of what, in my paper on the brain of the Sumatran Rhinoceros (*Trans. Zool. Soc.* vol. x. p. 411),[1] I term the middle oblique convolution (that between the lateral and supra-sylvian fissures), it most resembles the Camel and the Giraffe, from the form of which it strikingly differs in the much less 'pronation,' as Dr. Krueg terms it, of the hemisphere. On the whole, it stands very much by itself."

The Brain of the Bush Dog. (*Icticyon venaticus.*)—In the last number of the Proceedings of the Zoological Society (part i., 1880, p. 73) Professor Flower in the course of a paper on the anatomy of the Bush Dog (*Icticyon venaticus*) describes and figures the brain of this animal. This organ is stated to be characteristically canine, except that on the left side the gyrus immediately surrounding the Sylvian fissure is not marked off by a complete sulcus at the upper curved part from the one above it. It thus almost reproduces the condition met with in the Felidæ, from which form, according to the view of the late Professor Garrod, the canine brain has been derived by complete division of the lower or external gyrus into an outer and inner segment (Notes on the visceral anatomy of *Lycaon pictus*. *Proc. Zool. Soc.* 1878, p. 377.)

"Although I have no doubt," concludes Professor Flower, "after examining a larger number of specimens than were available when attempting a classification, and comprised of the cerebral convolutions of the different groups of the Carnivora, that the fourth—counting from the middle line—or inferior gyrus of the dog, is represented by the outer or inferior portion of the third (counting in the same way) of the other Carnivora, and is in many Æluroids already partially marked off by an interrupted sulcus, I am not prepared on that account to accept the conclusion that the dog is a further modification of the highly specialised Æluroid type. Very little else in the structure or the palæontological history of the dog indicates that it has passed through a feline stage in its development, and its more complex brain may have been cortical quite independently from a primitive form."

J. C. Galton.

[1] Abstract in 'Brain,' Part III., p. 418.

Exner on Cerebral Localisation.—At the meeting of the Academy of Sciences at Vienna, June 17, 1880, Exner gave the following as the results of his investigations on the functions of the cerebral cortex. He had limited his examination to cases of purely cortical lesions—169 in number—recorded in literature. The results, which will be published more fully at a later date, are, that in the cortex there are areas which are in relation with certain functions in a limited, and others in a more general sense.

In general it is lesions of the two central convolutions which paralyse or impair volitional movements on the opposite side. But in addition to these the greater portion of the convex surface of the hemisphere must also be reckoned in the motor zone, though of less significance.

In the motor zone there are areas corresponding to certain muscular actions which may be termed absolute, when lesion of these invariably causes affection of these movements; relative only, when this is not constant. Only the muscles of the extremities and the right side of the face have an absolute cortical area; the others, only relative cortical regions.

All the motor areas have a greater signification, and, in a certain sense, also greater extension, in the left hemisphere than in the right. They are not sharply demarcated, but cease gradually. Many muscles, those which are usually associated together, have areas in both hemispheres. Those muscles which usually act together, whatever their peripheral nervous supply, are intimately related together in the cortex.

As regards speech, the temporal convolutions are not less important than the frontal or the insula. Lesions of the temporal lobes, especially affecting the middle temporal convolution, cause the affection of speech termed "word deafness."

As to the sensory areas, it appears that as the left hemisphere is especially motor, so is the right especially sensory. The tactile areas of the extremities correspond with their motor areas. They are not separate, but the centres are conjoint sensory and motor.

The centre of vision is in the first occipital convolution, and, like the motor areas, shades gradually into the surrounding cortex. Lesions of this centre cause ocular hallucinations, or disorders of visual perception, or hemianopy. Each sensory centre seems to be in relation with both sides of the body.

H. Obersteiner.

Brachial Monoplegia.—Déjerine (*Prog. Méd.*, August 14, 1880) records a case of right brachial monoplegia, combined with contracture and tremor, and also with anæsthesia. The mobility of the face and leg was unimpaired, but the sensibility of the leg was greatly diminished, though less so than in the arm. The special senses were unaffected.

After death a tubercle of the size of a nut was found in the optic thalamus compressing the internal capsule towards its posterior aspect.

He considers this case especially interesting as showing that monoplegia may occur apart from purely cortical disease, indicating that the medullary fasciculi for the arm and leg remain distinct, and are capable of being individually and separately affected.

[The case however, complicated as it was with anæsthesia and tremor, is quite unlike monoplegia depending on cortical disease.]

Pitres on Cerebral Localisation.—Pitres (*Prog. Méd.*, Aug. 7, 1880) reports several cases which have recently come under his observation illustrative of the effects of cerebral lesions, according to their position within or without the motor region.

The two first relate to lesions of the sphenoidal, parietal and occipital lobes, without motor symptoms. The third was a case of lesion of the nucleus caudatus of the corpus striatum, also without motor symptoms, showing that when the lesions do not also involve the internal capsule paralysis does not ensue, and indicating, therefore, the necessity of accurately discriminating between lesions of the grey matter and the capsular fibres. The fourth case was one of extensive destruction of the motor zone and third frontal, causing persistent hemiplegia and aphasia. The fifth was one of right hemiplegia and hemianæsthesia, the lesion being in the internal capsule and foot of the corona radiata. The aphasia was explained by the extension of the lesion into the inferior pediculo-frontal fasciculus, thus cutting the medullary connections of the third left frontal, though the cortical substance was not destroyed. The sixth case was one of brachial monoplegia depending on limited lesion of the centrum ovale in the middle pediculo-frontal fasciculus. Secondary degeneration was demonstrated also in the spinal cord in two of the cases of lesion of the motor zone, and its absence demonstrated in one where a lesion of old-standing existed outside the motor zone—inferior parietal and sphenoidal lobes.

Kronecker and Nicolaides on Irritation of the Vaso-motor Centres by Summation of Electrical Stimuli.—In a paper on this subject (*Verhandl. der Physiolog. Gesellsch. zu Berlin*, No. 17, 1880) the authors arrive at the following results:—

Single induction-shocks applied to the vaso-motor centres of the medulla or below it, after removal of the cerebral hemispheres, have no influence on the blood-pressure, or only slight, with currents which are so strong that practically each shock is a tetanising one.

Moderately strong stimuli are only active—by summation—when they occur at least two or three per second.

These slowly repeated stimuli gain in effect when their intensity is increased, but it is never possible with such form of stimulation to cause the maximum effect such as is produced by moderately strong stimuli of greater frequency.

If the intensity remains constant and the frequency increased, the effect becomes more marked. The effect is not increased when the frequency of the stimulation exceeds 20–25 shocks per second.

This maximum of vascular contraction, which varies in different animals, can also be produced by strong stimuli of moderate frequency (10–12 per second), and also by moderate stimuli of maximum frequency (20–25 per second).

The maximum of vascular contraction in consequence of strong but less frequent stimuli is not reached so soon as by weaker and more frequent stimulation.

After the irritation of the vaso-motor centres ceases, the blood-pressure sinks gradually, just as in Ludwig and Baxt's experiments on the accelerator nerves of the heart, while the inhibitory action of the vagus very rapidly disappears. Hence, with vagi intact, irritation of the medulla oblongata at first only inhibits the heart, the blood-pressure first beginning to increase when the vagal irritation has subsided.

These laws apply also in the case of irritation of the peripheral ends of the divided splanchnics. Here, however, the intensity of the effect varies, as is known, with the animal.

The complete analogy of the above results with those obtained by summation of cutaneous electrical stimulation, allows the conclusions to be drawn—

1. That vascular constriction is caused by irritation of the medulla oblongata, spinal cord, and also of the splanchnics in a reflex manner.

2. That just as the motor cells of the spinal cord, under whatever form of tetanisation, vibrate with a constant frequency which

corresponds to the normal muscle sound, so the vaso-motor centres have a tone or vibration of their own—corresponding nearly to that of the muscles.

Marckwald and Kronecker on the Respiratory Centres.—Marckwald and Kronecker (*Verhandl. d. Physiolog. Gesellsch. zu Berlin*, August 9, 1880) publish the results of a research with reference to the influence of electrical irritation of the vagi on the respiratory movements. They find that animals (rabbits) whose medulla is severed by a transverse incision at the level of the *striæ medullares* of the fourth ventricle, continue to breathe for several hours in a fairly normal manner. In the medulla there are two distinct excitable centres, one inspiratory, and a weak expiratory, whose alternating action is the cause of rhythmical respiration. These centres are stimulated to action by the vagi, which are, however, supplemented by other centripetal nerves—such as the cutaneous nerves. This is shown by several facts. Section of the vagi in the neck puts a stop to regular respiration. By irritation of the proximal ends of both vagi, both inspiration and expiration can be excited, more especially inspiration. By rhythmic electrical irritation of the proximal ends of the vagi, reflex artificial respiration of a fairly normal type can be excited. This can be effected without the vagi, but less easily, by a powerful cutaneous irritation.

The inspiratory and expiratory centres seem to stand in a similar relation to each other as the vagus and accelerans, or as the vagus nucleus and the vaso-motor centre. A simple electrical stimulus of the vagus causes a respiratory movement only in combination with other stimuli. Continued or periodical tetanising irritation causes rhythmical respiration. Even during apnœa tetanising stimulation of the vagus causes incomplete respiratory movements. Single electrical stimuli do not produce this effect. These reflex respiratory movements are shown more especially in the diaphragm; but the other muscles of respiration are also capable of being similarly acted on, though the stimuli must then be stronger and more frequent.

Ferrier and Yeo on the Cerebral Visual Centres.—At the meeting of the British Medical Association at Cambridge, in August, Professors Ferrier and Gerald F. Yeo read a paper before the Physiological Section, in which they gave a preliminary account of

their recent investigation of the visual centres in monkeys. The operations were conducted under the Listerian antiseptic method, by which lesions can be established in the brain with a total absence of encephalitis or other secondary changes, which almost invariably accompany ordinary operative methods, and more or less complicate the results. After alluding to the previous views of Ferrier, Munk, Luciani and Tamburini, they gave the following as the results of their research :—

1. As to lesions of the occipital lobes.

They found that neither as the result of destruction nor bodily removal of one or both occipital lobes, provided the lesions did not trench on the parieto-occipital fissure, was there any discernible disturbance of vision, or other bodily or mental functions.

2. As to lesions of the angular gyri.

After complete destruction of one angular gyrus there is temporary loss of vision in the opposite eye, lasting only a few hours. The common sensibility of the eye remains acute, and there is no ptosis or other muscular paralysis.

The restoration of vision is not due to the integrity of the other angular gyrus alone. In regard to this point the results differ, according as the angular gyri are destroyed simultaneously in both hemispheres, or the one angular gyrus several weeks after the other, after complete recovery from the first operation. In the latter case vision is either not markedly impaired, or, if so, only in a very transient manner. Within a few hours an animal deprived of both angular gyri *successively* sees, to all appearance, perfectly well with both eyes. Even though the portions of the occipital lobes immediately adjoining the parieto-occipital fissures are also removed, vision is not perceptibly impaired. If, however, both angular gyri are destroyed *simultaneously*, total blindness ensues in both eyes. But this does not last more than three days. After this period the animal gives evidences of vision, though impairment of vision is distinctly indicated as long as a month afterwards.

It follows, therefore, from these facts that without its occipital lobes a monkey *continues* to see; and that without its angular gyri it can nevertheless *regain* its sight.

3. As to destruction of the angular gyrus and occipital lobe together on one side.

This lesion causes very evident loss of vision in *both* eyes towards the side opposite the lesion. Whether the hemiopia is quite symmetrical they do not decide positively, but they regard the bilateral affection to be unquestionable. This hemiopia is, however, also

merely temporary. At the end of a week there is distinct indication of vision to both sides.

Remarkable results were obtained by what may be described as diagonal lesions of the visual centres.

In an animal whose left angular gyrus had been destroyed (recovery), the right angular gyrus and occipital lobe were destroyed. As the result of this there was left hemiopia, from which, however, the animal recovered completely within a fortnight. This animal, therefore, had only one occipital lobe.

In another animal which had had both occipital lobes previously removed without symptoms, the left angular gyrus was destroyed. The first effect of this was transient loss, followed by indistinctness of vision in the right eye. Within twenty-four hours the animal was again perfectly well, and in full possession of its visual faculties. In this case one angular gyrus alone remained.

From these two cases, therefore, it appears that one occipital lobe or one angular gyrus can suffice for vision with both eyes.

4. As to destruction of both angular gyri and both occipital lobes.

The result of this lesion is total, and to all appearance permanent, blindness in both eyes, without any impairment whatsoever of the other sensory faculties or motor powers. An animal with this lesion had, after months, gradually acquired some considerable confidence in its movements; but though in some of its actions it sometimes appeared as if it saw, yet the authors had never seen any indubitable indication of vision, or anything not more easily explicable by the keenness of its other faculties.

They regard this result as one of the most conclusive demonstrations of the localisation of function in distinct cerebral regions.

Debove and Gombault on the Decussation of the Sensory Tracts in the Medulla Oblongata.—In a note on this subject (*Archives de Neurologie*, part i. vol. i., July, 1880), Debove and Gombault, after indicating the views of Meynert, &c., state that the sensory tracts fuse more or less completely with the motor tracts. This is rendered evident by the examination of a case of amyotrophic sclerosis in which the medulla was affected. The note is illustrated by figures.

At the lower portion of the decussation the sensory fibres divide into small bundles which penetrate the pyramids in their posterior and external aspect, and then curve round and follow a course parallel to them and mixed up with them.

A little higher the decussating sensory fibres penetrate the motor pyramids in their posterior and middle aspect. A certain number of them fuse with the fibres of the stratum zonale.

At the upper extremity the sensory fibres follow different courses. The most superficial penetrate the pyramids at their external aspect. The most deep apply themselves to the posterior and external aspect, and ascend vertically. Hence it appears that the greater portion of the sensory tracts after decussation become intimately mingled with the motor pyramidal strands.

Debove and Boudet on Ataxic Incoordination.—MM. Debove and Boudet (*Archives de Neurologie*, vol. i. part i.) from an investigation of the muscular system of ataxics support Lockhart Clarke's view that the incoordination of ataxics depends on *inequality* of the muscular tone. An examination of the muscles by the *myophone* (see Boudet, *Soc. de Biologie*, Jan. 1880) indicates considerable differences in the tone of different muscular groups. The habitual diminution of tonicity in the quadriceps cruris accounts for the absence of the "tendon-reflex." In order that this should be manifested a certain tension of the muscles is necessary. Differences are also demonstrable in the latent period between percussion and contraction of different muscles. The inequality of tone serves to account for the ataxic incoordination. It is not the total absence of muscular tonus, such, for instance, as may be induced by action of the posterior roots. This operation in animals causes a peculiar defect in movement, but it is not the same as ataxy.

Though the muscles are unequal in tone, yet the absolute contractile force does not seem impaired, for tonic and atonic muscles, *cæteris paribus*, will contract equally powerfully. The difference is in the degree of stimulation they require. A tonic muscle will reach its maximum contraction sooner than an atonic one. Hence the same volitional stimulation will affect these muscles unequally. The irregularity is most manifest in movements requiring only moderate muscular force, such as standing and walking. The more energetic the movement, the less does the inequality of tone manifest itself. Hence ataxics in all their movements, whether of prehension or locomotion, exhibit a *brusquerie* and exaggeration, which is an attempt to correct the incoordination by a maximum contraction of all the muscles involved.

Gaskell on the Tonicity of the Heart and Blood-vessels.—In the *Journal of Physiology*, vol. iii., No. 1, Gaskell discusses the

influence which alterations in the nutritive condition of the muscular substance of the heart and blood-vessels have on their tonicity. It is commonly supposed that the condition of the heart and the tonicity of the vessels are regulated by purely nervous mechanism, but the experiments he has made on the influence of acids, alkalies, and other substances, seems to indicate that something at least must be ascribed to the nature of the fluids which bathe the tissues. Dilute alkaline solutions have a tonic or constrictive action on the muscular tissue of the heart and arteries; while dilute acid solutions have an opposite or atonic influence. Variations in the alkalinity will affect the tonicity. He supposes that the acidity generated in organs by activity may be influential in causing the dilatation or atonic condition of the blood-vessels which accompanies activity. During rest the tissues are alkaline, and therefore the vessels are in a state of tonicity. In the case of the heart he suggests that the normal beat depends partly upon the maintenance of a due tonic condition of the muscular tissue, which tissue is capable of variation between two opposite extremes of tonicity and atonicity (systole and diastole). He considers various hypotheses as to how this may be brought about, and as to the similar action of digitalis, and certain other cardiac agents. On these the reader is referred to the paper itself. He proposes to discuss at a future date the bearing of his observations on the theory of inhibitory nerves, the nature of recovery of tonicity after removal from the central nervous system, and the action of alkaline medicines and digitalis in the febrile state.

Gombault on Segmentary Peri-axillary Neuritis.—Gombault (*Archives de Neurologie*, vol. i. part i., July, 1880), publishes the first instalment of an investigation of a form of neuritis, designated as above, which in appearance is essentially different from the Wallerian degeneration of nerves. His researches are based mainly on the effects of lead-poisoning in guinea-pigs. In these animals, after administration of lead for several months, changes were induced in the nerves of the characters described, though they did not exhibit any signs of lead paralysis. For a full description reference must be made to the original paper, which is copiously illustrated. The chief points of difference between the segmentary neuritis and the Wallerian degeneration are as follows. In the latter the degeneration is visible simultaneously throughout the whole length of the fibre, and affects the axis cylinder as well as other parts. Regeneration is possible by the development of new

tubes. In the segmentary axillary neuritis, however, the degeneration affects only portions of a nerve, the axis cylinder remains unaffected, and regeneration takes place by the formation of a new sheath of myeline round the intact axis cylinder.

This peri-axillary neuritis also occurs in man, and the author refers to cases of muscular atrophy, amyotrophic lateral sclerosis, and traumatic neuritis, in which the characters of this form of neuritis were distinctly indicated. In man, the Wallerian degeneration is also frequently observed in conjunction with peri-axillary neuritis, and the question will be whether these two forms of parenchymatous neuritis are distinct, or whether they are only different phases of the same morbid process.

Grasset on Locomotor Ataxy and Heart Disease.—In a short and suggestive paper published in the *Montpellier Médical* for June 1880, Grasset brings forward certain facts which tend to establish a causal relationship between locomotor ataxy—especially the painful form—and cardiac lesions. Berger and Rosenbach have already (*Berl. Klin. Wochensch.*, July 7, 1879) published seven cases of the coincidence of locomotor ataxy and aortic incompetency, and think there is some special relationship between the disease and this particular valvular lesion; but Grasset brings forward two cases observed by himself, and cites fifteen others from different authors, in which locomotor ataxy and cardiac valvular disease of various kinds had been noted. There is, therefore, no special relationship between aortic disease and ataxy. The question is whether the two diseases are merely coincidences, or whether there is any causal relationship between them. There certainly does not seem any ground for regarding the ataxy as secondary to the cardiac affection; nor, on the other hand, is there any indication in the cases recorded of the cardiac affection being due to direct action of the diseased cord.

The majority of the cases of tabes complicated with cardiac affection have been remarkable for the intensity and duration of the pains. Hence arises the question whether we may not attribute the cardiac disease to the *painful* character of the malady.

In support of this method of causation Grasset quotes several recent physiological researches—more especially those of Franck, and of Couty and Charpentier—on the influence of irritation of sensory nerves, and of *conscious* pain (emotion, &c.) on the circulation. That such agencies affect the heart—causing stoppage, retardation, quickening, and variations in the vascular tension according to

circumstances—is clearly established by these as well as by many former researches; and that such agencies may actually lead to the establishment of organic cardiac disease is not only possible, but is strongly indicated by many clinical facts.

Most of those who have directed attention to the etiology of cardiac disease—apart from the all-overshadowing rheumatic origin—more especially those observed in connection with gastro-hepatic ailments, have endeavoured to furnish a mechanical explanation secondary to changes in the pulmonary circulation. Grasset, however, has a wholesome distrust of purely mechanical explanations, and looks rather to a direct reflex effect on the heart itself originating from the painful nature of the malady. In this direction, therefore, he looks for an explanation of the probable relationship between ataxy and heart disease.

Tschiriew on Lesions of the Spinal Cord and Skin in a case of Anæsthetic Leprosy.—In the *Archives de Physiologie* (2me série, 1880, p. 614), Tschiriew publishes the results of his microscopical examination of the spinal cord and finger of a leper who died under the care of M. Hillairet in the Hôpital Saint-Louis, in May 1875. The parts had been preserved in a solution of bichromate of ammonia. Nothing abnormal was discoverable in the brain or spinal cord at the post-mortem examination by mere naked-eye inspection.

On microscopical examination of the spinal cord in the *cervical* region, there was no appreciable alteration in the configuration of the white and grey substance. The central canal and its neighbourhood were filled with small rounded granules, colouring intensely with purpurine or hæmatoxyline. In the white and grey substance small, more or less elongated, bodies were scattered, taking on colour also very readily. The medullary veins were congested. In the middle of the cervical region, but only on the left side, there were capillary hæmorrhages occupying the anterior part of the posterior horn.

The anterior horns, with their cells and processes, were normal.

In the posterior horn there were the following changes. The number of the cells was diminished, and they were more or less altered; only a few could be discovered with processes. In general they were reduced to rounded bodies, but retained nucleus and nucleolus. Others had not merely lost their processes but their margins were indistinct, and the protoplasm surrounding the

nucleus reduced to a very thin layer. These cells were sometimes surrounded by lacunæ. There were no vacuolated or pigmented cells (Hayem, Déjerine), nor were any distended (Charcot) cells visible.

The grey substance itself occasionally was without any trace of organisation, being reduced to a more or less opaque, granular mass, taking on colour more intensely than the normal tissue.

In this mass there were small bodies of a rounded form, probably resulting from the atrophied nerve cells.

All the lesions, with the exception of the hæmorrhages, were symmetrical.

The *dorsal* and *lumbar* regions presented similar appearances—the hæmorrhages excepted. There was also alteration of the cells of Clarke's vesicular column, chiefly at the upper and middle regions. The changes were not always equally marked on both sides. A few of the cells of the anterior horns of the dorsal region had fewer and less distinct processes than normal, but those of the lumbar region were perfect.

The *anterior roots* were normal; the *posterior* roots had their sheath a little thickened. The ganglia of the posterior roots had not been preserved.

The *skin* had undergone alteration chiefly in the cutis and subcutaneous tissue. There were infiltrations of small rounded lymphatic or embryonal cells, chiefly in the vascular regions around the glands, and in the adipose tissue. The infiltration seemed to proceed from the small vessels and capillaries, as it was thicker around these than in the neighbourhood of the larger vessels. There was well-marked endarteritis of the vessels.

The *nerves* of the finger were only discoverable by their position, being converted into bundles of connective tissue containing a few small rounded cellules.

The changes observed in the spinal cells Tschiriew regards as being due to *simple degenerative atrophy*, as distinct from pigmentary, vascular, sclerous, &c. As to the grey matter the change seems to be due merely to a destructive parenchymatous process.

What relation there is between the degeneration of the cells and of the grey matter, and the connection between these and the phenomena of anæsthetic leprosy, are all questions which it will be for future research to decide definitively.

Pott's Disease and Progressive Muscular Atrophy.—Proust and Ballet (*Revue Mensuelle*, June 1880) record a case of Pott's

disease in which there was typical muscular atrophy in the thenar eminences and interossei muscles.

On microscopical examination after death there was found sclerosis of the internal radicular zones of the posterior cornua similar to what is seen in locomotor ataxy, atrophy of the anterior horns, and degeneration of the anterior roots of the cervical region, middle and inferior; and lastly, atrophy of the muscular fibres corresponding.

Muscular atrophy is not common in Pott's disease. As to the pathogeny, the authors, after considering the hypothesis of pachymeningitis and ascending or descending degeneration consequent on compression, believe that the condition can best be accounted for as follows. The irritation of the posterior roots by the neoplasia, propagated to the strands of Burdach by the internal root zones, sets up a periradicular inflammation and sclerosis. This propagated to the anterior horns, leads to a degeneration of the multipolar cells and thus to muscular atrophy. They quote some observations by Michaud (*Sur la méningite et la myélite dans le mal vertébral*, Thèse, 1877) in support of myelitis thus capable of being induced. D. FERRIER.

The Pathology and Pathological Anatomy of the Central Nervous System.—Kahler and Pick contribute a lengthy paper on this subject to the *Archiv für Psychiatrie*, vol. x. parts 1 and 2. The cases, especially the histological results, are reported with great fulness and care.

(1.) *Disease of the Posterior and Lateral Columns.*—A man, aged 39, who had often been in hospital suffering from chronic myelitis, died of typhus fever. In the fresh state the cord showed no marked signs of disease, but after hardening the following changes were observed: In the cervical and upper dorsal regions the margins of the cord were converted into a belt of sclerosis. In the lower dorsal and lumbar regions there was a systematic affection of the pyramidal tracts of the lateral columns, in the cervical region the systematic nature of the lesion was less evident owing to the implication of other parts, but the sclerosis was further advanced in the pyramidal tracts than elsewhere. The disease had spread by contiguity to the lateral limiting layers (seitlichen Grenzschicht der grauen Substanz, of Flechsig). The direct cerebellar tracts were sclerosed, and from the fact that the cells of Clarke's columns with which they are connected were abnormally few in number, Kahler and Pick think that the sclerosis of these tracts was not merely an

extension of the disease from neighbouring parts, but was an independent, systematic affection. There was sclerosis of the inner parts of the anterior columns, but whether this was a systematic affection of the pyramidal tracts of the anterior columns or an extension of the marginal sclerosis, is not known. In the upper cervical portion of the cord, the pathological changes in the posterior columns were chiefly limited to Goll's columns, in the lower cervical and upper dorsal portions to the *zones radiculaires post.*, Goll's columns being here almost intact. In the grey matter of the cervical region was a focus of granular degeneration. In a case of secondary descending degeneration, Eisenlohr has described a similar focus in the dorsal region. The two cases go to show that with chronic systematic affections of the white matter may be combined acute affections of the grey matter. As the clinical history is incomplete, the authors leave it undecided whether this was a case of combined systematic disease or a complication of two or more systematic diseases.

(2.) *Compression of the Cord.*—A girl, aged 18, fell on her back and fractured the sixth cervical vertebra. An examination shortly afterwards revealed complete loss of motility and sensibility in the lower extremities, paresis of the arms and paralysis of the bladder. Twelve days afterwards a large bed-sore had formed in the sacral region, and seven weeks afterwards the arms became paralysed. The patient died twelve weeks after the accident. Before death the original bed-sore had almost healed. The cord opposite the 6th cervical vertebra for a space of $1\frac{1}{2}$ ctm. was completely destroyed. Between the thickened and approximated membranes was a small remnant of tissue which was seen to be a network of fine fibres, in the meshes of which were large, flat, slightly granular cells of an epithelial type. Blood-vessels with thickened walls ran in the tissue, and the dilated lymph-channels which surrounded them were filled with cells similar to those just described. There was scarcely a trace of nervous structure. Above and below the point of injury the cord presented the appearances characteristic of myelitis from compression. In some places where the fibres had disappeared from their framework, their place had been taken by endothelial cells. Those portions of the cord that lay next the dura often showed a wide-meshed reticular structure with here and there tube-like spaces. Both meshes and spaces were filled with endothelial cells. Leyden thinks that these cells are analogous to granule-cells, and spring from the neuroglia elements. Kahler and Pick, on the other hand, regard them as growths origi-

nating from the endothelium of the adventitious lymph-spaces. They have to do, perhaps, with a process of regeneration.

For some distance above the place of injury there was ascending degeneration in the direct cerebellar tracts, in Goll's columns, and to a less extent in the adjoining portions of Burdach's columns. In the lower segment of the cord a short tract of secondary degeneration was observable in the posterior columns, and in the same columns was a focus consisting of closely packed endothelial cells and fragments of medulla. A similar focus has been described by Westphal, and it is probably an independent patch of myelitis resulting from the shock of a severe injury. It is allied to the traumatic degeneration of Schiefferdecker.

The inconstancy of the occurrence of ascending degeneration of the direct cerebellar tracts after injury of the lateral columns has often been commented on. Bouchard thought the height of the lesion determined its appearance or non-appearance; when the lesion lies above the mid-dorsal region there is degeneration, when below it there is none. Flechsig attributes the different results to the character or degree of the lesion. Kahler and Pick show by reference to a table of twenty-seven cases of secondary ascending degeneration that neither theory embraces all the cases. But if we remember, first, that the direct cerebellar tract as it ascends from the upper lumbar portion of the cord to the inferior cervical portion, is continually reinforced by fibres from the cells of Clarke's columns, and secondly, that it is only the fibres which are cut off from their connection with these cells that degenerate, we have an important clue to the condition in any case of the cerebellar tracts. In lesion of the lumbar enlargement there is no degeneration; in lesion of the lower dorsal region few fibres are degenerated, and these are often difficult to find among the numerous normal fibres; besides a considerable number of the fibres of this part of the cerebellar tract run among the fibres of the lateral pyramidal tract. It is only in lesions of the cervical and upper dorsal regions that we have a compact band of degeneration. And yet not invariably even in these, for, in the second case reported, fracture of the cervical vertebræ with death in seventeen days, there was degeneration neither in the cerebellar tracts nor in Goll's columns, though there was distinct descending degeneration in the pyramidal tracts. In this case it is important to note the absence of the knee, abdomen, and cremaster reflexes.

(3) *On the Time of Appearance of Secondary Degeneration.*—Türck thought six months were required for the development of

secondary degeneration, but he was misled by regarding granule-cells as the only structures pathognomonic of secondary degeneration, whereas in point of fact the formation of granule-cells is consecutive to the degeneration, and is not a criterion of its presence or absence. Bouchard observed secondary degeneration fourteen days after compression of the cord, and sixteen days after an apoplectic attack. Barth found it five weeks after a cerebral lesion, and Müller thirteen days after a traumatic compression of the cord in the cervical region. Schiefferdecker, experimenting on dogs, noticed it on the fifteenth day, while Leyden, after inducing myelitis in dogs, observed degeneration of Goll's strands within a month. In the second case of compression of the cord (see *ante*) there was secondary degeneration seventeen days after the injury, and Kahler and Pick report another case in which secondary degeneration was observed eleven days after a lesion of the corpus striatum, optic thalamus, and external capsule. These cases cast doubt on Leyden's theory that the degeneration after traumatic or primary lesions of the cord develops more rapidly than after brain lesions. Some have thought that the ankle-clonus is dependent on secondary degeneration. But this view is untenable, for Westphal in a case of apoplexy with hemiplegia and contracture, observed both knee and ankle phenomena, which had previously been absent, one hour after the attack. Besides there are cases of secondary degeneration in which it is impossible to evoke the phenomenon of ankle-clonus.

W. J. Dodd, D. Sc.

(*To be continued.*)

Cortical Lesions of the Cerebral Hemispheres. (*Gazette des Hôpitaux*, January 24, 1880.)—Dr. H. de Boyer has presented a thesis to the Faculty of Paris, entitled 'Clinical Studies on the Cortical Lesions of the Cerebral Hemispheres;' and Dr. Gaston Decaisne, 'On Cortical Paralyses of the Superior Extremity—Brachial Monoplegia.' The following are the principal conclusions deduced from clinical observation, more particularly in reference to treatment.

First. *Of the principal cortical lesions; the determination of the latent zone and motor areas.* One of the most important of M. de Boyer's inferences is that which treats of the existence of latent tracts, non-motor or neutral, by the side of the motor areas. Cerebral lesions do not necessarily cause motor disturbances, it depends upon their situation. It is important to recognise the latent areas, because we thus can circumscribe these non-motor tracts, and by

exclusion demonstrate the existence and seat of a motor area on the cortex.

It appears already demonstrated that the motor centres occupy the circumference of the fissure of Rolando and the neighbourhood of the fissure of Sylvius. The localisation of aphasia consists of three lesions—of the cortex of the third left frontal convolution, of the island of Reil (at present under observation), and of the pediculo-frontal fibres of the third left frontal. The centre for language is in the posterior third of the third left frontal, and round the ascending ramus of the Sylvian fissure.

The lesions of partial epilepsy are never found in the base of the brain. Cases of monoplegia are alone sufficient to enable us to fix the exact seat of a centre. Associated monoplegias indicate the extension of a centre—whether this influence of one motor centre on another takes place by the superposition of the edges of two contiguous centres, or whether the white fibres derived from the two decussate in the interior of the hemisphere. We may observe the following monoplegias: aphasia, facial, brachial, or more rarely crural monoplegia, ptosis, rotation of the neck, or deviation of the eyes. These may be associated—the speech with the face, the face and the arm, the arm and the leg; but never with a single circumscribed lesion do we see monoplegia of the face and the leg, or the speech and the leg. The centre for the arm occupies the space between that for the face and that for the leg. We often find monoplegia of the arm associated with other monoplegias, most frequently with that of the leg, constituting incomplete hemiplegia, without facial paralysis. The centres thus range themselves from below upwards, along the fissure of Rolando, and govern their respective muscular masses in an inverse order; thus, the area for the face is lowest in the brain, while that for the leg is highest. The following centres may be fixed: Language, the posterior third of the third left frontal. Face, the inferior frontal and ascending parietal. Arm, the middle third of the frontal and ascending parietal. Leg, the superior third of the ascending parietal.

Clinically we may observe the following paralyses, corresponding to a single lesion: Loss of language; paralysis of the face; of language and face; of the arm; of the arm and the face; of the arm and loss of language; of the arm and the face and loss of language; of the leg; of the leg and the arm; of the leg, of the arm and the face; of the leg, of the arm and loss of language; of the leg, of the arm, of the face, and of loss of language.

Second. *Paralysis of Cortical Origin of the Upper Limb* (*Brachial Monoplegias*).—This study is based on clinical observations chiefly, and the following are M. Decaisne's principal conclusions:—

In general there is no apoplectic stroke, properly so called; there is merely a giddiness, a trembling or loss of power, and the patient retains a more or less distinct idea of what is passing. Often there is a temporary embarrassment of the speech, and the leg first attracts his attention, the weakness of the arm not being noticed for a little time. The general symptoms soon dissipate, and the arm is left alone affected. The most striking symptom is the conservation of the sensibility. It is merely blunted, and that at the first onset. Should sensation not soon be recovered, it argues an extension of the cortical lesion. Sensation to heat and cold remains intact, and the temperature of the limb is unaffected. Most frequently the paralysis is incomplete, merely an enfeeblement. Usually, having been at the first onset general, it eventually settles in certain groups of muscles—e.g., the flexors or extensors, most commonly in the latter, or in certain segments of the limb, the forearm, wrist, or fingers. Inversely, the paralysis may progressively attack other groups of muscles than those first affected; thus developing into a hemiplegia. The lower part of the face may be temporarily paralysed in this disease; but should the symptoms extend to the upper part, it is no longer a case of brachial monoplegia. Should the lesion be permanent, motion may be re-established by the assistance of neighbouring cells. The prognosis depends on the extent of the lesion and its cause. If the lesion be limited, if it be a thrombosis, embolism, or hæmorrhage affecting a limited vascular supply—if the affection be purely local—a speedy recovery is the rule; and if, on the other hand, the lesion involves the whole group capable of taking the place of the destroyed cells, it is irremediable. Should the first cause be such diseases as cancer, tubercle, &c., the prognosis will of necessity be bad, even with a very limited lesion; but an extensive alteration may be quite remediable as in syphilis.

In these cases, then, the characteristic symptoms are the limited, incomplete, and transitory nature of the paralysis, the preservation of sensation, and the normal temperature of the affected part.

A. R. Urquhart, M. D.